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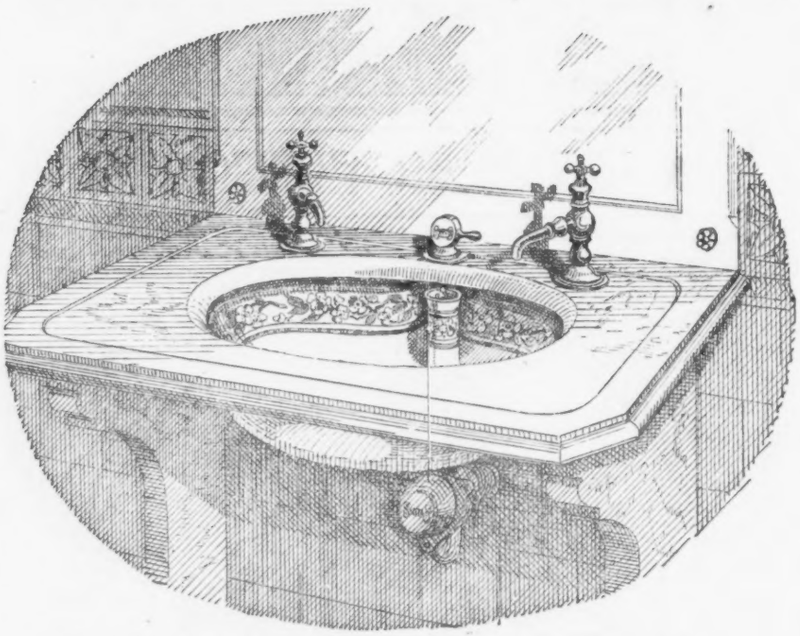
Church, Dayton, Ohio.
Houses, New York, N. Y.

THE SANITAS LAVATORIES.

(BASIN, BATH-TUB, PANTRY-SINK.)



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THE AMERICAN ARCHITECT AND BUILDING NEWS.

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THE profession of architecture has lost a true friend in the death of Alexander James B. Beresford-Hope, which occurred late last month. Mr. Beresford-Hope was the son of Thomas Hope, a member of the great and ancient commercial house of Hope & Company, of London and Amsterdam, whose Amsterdam house, under the old name, still overlooks the calm water of the Prinsen Gracht. The elder Hope, as well as a very rich man, was a devoted amateur of what might be called applied fine art. He fitted up his London house with furniture entirely designed by himself, and filled it with a collection of pictures and statues which has become famous. Soon after this house was completed, he published a description of it, with illustrations, under the name of "Household Furniture and Decoration," which produced a sensation in its day comparable to that which followed the publication of Eastlake's "Hints on Household Taste" in our own time. After this, he interested himself in architecture and archæology, and published a book on mediæval architecture, illustrated by himself, besides the well-known "Costumes of the Ancients," which has become one of the classics of archæology. Although he died when his son Alexander was but ten years old, the latter inherited his father's passion for art, and particularly for architecture. While quite a young man, he bought a ruined abbey and refitted it as a training-school for missionaries, and published several books on church architecture. His treatment of this subject won him recognition among architects as an expert, second in attainments and ability to few in the profession, and, in return, he took great pleasure in attending the meetings of professional bodies, and taking part in their discussions, and was elected one of the earliest presidents of the Royal Institute of British Architects. Although a very busy man, being for thirty years a member of Parliament, as well as the proprietor and manager of the London *Saturday Review*, and the author of a great number of magazine and review articles, besides various novels and other books, he almost always found time to attend the Institute meetings, and took part in its affairs with a sincere but modest interest. During the past year his failing health had compelled him to give up his active participation in professional matters, to the great regret of his fellow-members, who watched the progress of his infirmity with solicitude, and will deeply mourn his death. Although not extremely conspicuous in politics, Mr. Beresford-Hope was at one time a member of the Queen's Privy Council, and was indirectly connected very closely with the Government through his marriage, which took place immediately on his graduation from college, with Lady Mildred Cecil, the sister of the present Marquis of Salisbury, the real ruler of the British Empire.

AN outrageous case of conspiracy by labor-autocrats against other people's business has been discovered in New York, and the conspirators are on the way to what we hope will be exemplary punishment. Not long ago, as we learn from the daily papers, Messrs. Merritt and Company began the construction of sixty-one houses, occupying several contiguous blocks on Seventh Avenue, about Seventy-fifth Street. The firm made a contract for plumbing some of the buildings with a plumber named Austin. Everything went on well until Mr. Austin got into some sort of dispute with the Plumbers' Union; whether on account of employing inadvertently a non-Union man, or for some other cause, we are not informed. The Plumbers' Union, finding Mr. Austin indisposed to obey its commands, seized upon Messrs. Merritt and Company as cats-paws to beat Austin with, and, although they were on good terms with all their men, threatened them with vengeance unless they undertook to coerce Austin. They declined, and the Plumbers' Union applied to the Central Labor Union, which declared war on Merritt and Company. As the latter succeeded in getting men who were not subjects of the Union to work for them, the Board of Walking Delegates betook themselves to the dealers in materials, to try to deprive their victims of the means for carrying on their buildings. Hearing that Merritt and Company had bought a cargo of brick from a certain dealer, and that the vessel was lying at the pier, they applied to the Boatmen's Union, who immediately moved the vessel out into the stream, and threatened the captain with violence if he dared to unload any of the cargo. Not content with this, the walking delegates went to all the principal dealers in materials, and threatened them with boycotting and the ruin of their business, if they sold any goods to Merritt and Company. Most of them submitted at once, and notified the unfortunate firm by letter that they could sell them no more materials. One, however, had the courage to remonstrate, saying that he did not think it fair to make such a demand. The reply was that the Board of Delegates would stop his business; and three days later all the drivers and truckmen in his employ left their work, informing him that they had been ordered to do so by their Unions. As he had kept a hundred and sixty horses, with their drivers, constantly busy hauling building materials, the strike of his teamsters put a complete end to his operations, involving him in great losses, simply because he had been a little slow in clubbing another innocent man, who had neglected to club a third man, against whom the walking delegates had a grudge. Meanwhile, the Messrs. Merritt, deprived of supplies, were compelled to stop work on their buildings, at an immense cost for deterioration and loss of interest on the money which had already been invested in them, and in the land on which they stood. Taking this investment at a million dollars, which is probably far below the truth, the interest charge alone would be about two hundred dollars a day, yet the judge of the court into which the conspiring delegates were, after some trouble, brought, coolly admitted them to bail in seven hundred dollars each, and postponed their examination for nearly three weeks, at the request of their counsel, who asked that his clients might not be disturbed about the matter "till after election."

THE *Iron Age* quotes from the records of the Texas Supreme Court a recent decision of much interest to contractors, and, we imagine, to lawyers. A builder estimated upon an addition to a house, offering to build the addition for eight hundred and fifty dollars, according to the plans and specifications furnished by the owner's architect. His bid was accepted in due form, and he commenced the work. When it was nearly finished, but before he had been paid, the house was burned. No time had been fixed for the payment of the contract price, or of any part of it, but immediately after the fire he demanded payment of the full amount. The owner resisted, on the ground that he had not received the building which the contractor had agreed to furnish complete, adding that the builder, instead of trying to indemnify himself out of the owner's pocket for the destruction of his work before it was delivered, ought, if he did not wish to bear the risk alone, to have insured his interest in the usual way. The lower Court, however, refused to hear evidence on this point, and ordered judgment for the plaintiff, and the Supreme Court sustained the decision, saying that "if a builder be willing to trust to the solvency of the person for whom he does work and furnishes

material, the latter has no right to thrust upon him the burden of insuring the property on which he does work." With all respect for the Supreme Court of Texas, this seems to us very queer law. A builder, who is sure of his lien upon the structure which he erects, as well as the land on which it stands, to the exclusion of all other creditors, need not usually trouble himself about the solvency of the other party to the contract; and in any case we cannot see the connection between this question and that of the duty of the proprietor to a risk which is not his, and which he cannot even estimate intelligently. The managers of insurance companies in Texas may be more amiable than they are in other places, but those which we have dealt with have always claimed that until the owner had paid, at least in part, for a building under contract, he had no insurable interest in it, and could collect nothing, in case of loss, no matter how many policies he had taken out. He might possibly, it is true, take out a policy payable to the builder, but in this case, on the Texas theory, he would still be bound to pay the contract price for the building destroyed, while the builder could collect the indemnity, and do as he liked with it.

THE second part of the Supreme Court's opinion was about as remarkable as the first. Leaving the particular case in hand, and ascending to generalities, the judge remarked that "Some courts have decided that when the contract is for an entire piece of work nothing is due to the workman until the contract is fully completed, but we are not disposed to follow these courts. We think that even when a workman abandons a contract he should be paid for what he has furnished and done at a price to be fixed by the value of the material and work and labor, not, however, in excess of the contract price." We shall not undertake to enter here into the question of entire contracts, preferring to leave that to lawyers, but we are disposed to think that the authority of "some courts" in regard to the matter is so highly esteemed in other places that it would be a hazardous experiment for a contractor in any State but Texas to abandon a contract wilfully before completion and try to collect payment in full for what he had done.

ONE of the new building materials which is likely to be found useful in many ways is common salt. Among the carpenters salt is now found to be useful as an aid to the heating of glue. Where, as is usual in joiners' and cabinet-makers' shops, the glue is melted in a jacket-kettle, surrounded by water, it is said to be advisable to put salt in the water in the outer kettle. The addition of salt raises the boiling point, and therefore allows the glue in the kettle to be kept at a higher temperature than could be maintained with water alone, and this is advantageous to the work. The masons find their use for salt in adding it to cement-mortar in cold weather, to preserve it from the bad effects of freezing. It is not quite clear why the salt should act in this way, as the beneficial results of using it are visible with mortar which has certainly been frozen, and frozen salt water expands nearly as much as fresh water; but engineers and contractors who have tried it are unanimous in their opinion of its value. In many cases masonry has been laid in cement in cold weather, using a considerable proportion of salt in the mixture, which, after repeated freezings and thawings, has remained in perfect condition, while work near by laid in mortar of the same kind, but without salt, has been disintegrated by the frost.

A REMARKABLE description of the effects produced in the African desert by the sinking of artesian wells is given in *Le Génie Civil*. Every one remembers that in the southern part of Algeria and Tunis, nearly parallel with the coast, stretches a chain of valleys, or rather, of flat low-lands. many portions of which are below the level of the Mediterranean. A few years ago, the late Captain Roudaire earnestly advocated the cutting of a canal to connect these depressions with the Mediterranean, with the idea that the shores of the salt lakes so formed would be rendered fertile. In the course of the investigations made by the French Government to ascertain the feasibility of the scheme, several artesian wells were sunk for a temporary purpose, which yielded such an abundant supply of water that later comers were induced to bore similar ones for permanent use. All these flowed so freely that by degrees the scheme for forming an inland sea was forgotten, and well-sinking was begun on rather a large scale, with the effect of changing the whole aspect of the place, which now, from a waste of sand, continually encroaching on the few oases, has become a thriving region dotted with orchards and gardens, and increasing daily in wealth and population. The investigations of the French engineers who have wrought this change have shown, that theirs are not only by no means the first artesian wells sunk in the desert, but that long before the people of Artois had thought of boring the deep wells known by their name, the Arabs of the desert had sunk them with perfect success.

ACCORDING to the native tradition, the wells which maintained the fertility of the ancient oases, and some of which still remain, were first drilled by a supernatural being with two horns, who reigned over the country in prehistoric times. This hero, after endowing his country with prosperity and abundance by means of his magical invention, disappeared, leaving the secret of his processes to a few disciples, who have handed it down to the present day, although for many years no one has attempted to put them in practice. The valley consists geologically of a basin of stratified rock, filled in with sand and alluvium, or rather, perhaps, with wind-blown dust. The strata of the underlying rock are turned upward on the sides of the surrounding hills, and the spring-water from the hills flows down between the layers, accumulating at the bottom in such a way that if the first stratum of rock is pierced at the bottom of the basin, the water rises through the superincumbent mass to the surface of the ground. The antique way of reaching the subterranean store was to dig by hand through the alluvial deposit to the rock, and pierce this in the simplest way. As the average depth to the water-bearing layer was two hundred feet, this was a serious undertaking for the poor Arabs, and the disciples of the horned prince, who alone had the right of well-digging, were accustomed to offer incense to the genii, and raise their spirits by a dose of hashish before commencing their task. The first operation was to dig in the sand a circular basin to catch any possible surface-water, and prevent it from running into the well where the "burrower" was at work. This done, the latter tied a rope of palm-fibre around his waist, leaving the end to the care of the villagers assembled at the mouth of the pit, and began digging a hole in the sand and gravel, removing the excavated material by means of a basket, which was drawn up and emptied by the volunteer assistants on the surface. As the pit deepened, it was necessary to stay the sides to prevent them from falling in, and this was done by means of small palm trunks. Time is not very precious in the desert, and a good many rests were necessary before the excavator reached the rocky crust beneath which the water stood. After a little experience, it was easy to determine the thickness and resistance of this stratum, and the debris on its surface was carefully removed, until only a thin shell remained. At this point the more adventurous spirits would, with a sudden blow, break the crust, signalling at the same time to their friends above ground, who would haul them up in time to escape the rising water. In many cases, however, the people on the surface were not active enough, and the excavator was drowned in his own well, so that the more cautious operators usually contented themselves with scraping the rock-crust as thin as they could with safety and breaking it, after they had themselves reached the surface, by dropping a large stone down the shaft. Unfortunately, for the people of the oases, these hand-made wells braced with wood, decayed in the course of centuries, the palm-trunks rotted, and the sand fell in, choking the well and shutting off the water-supply of the oasis, and by degrees the region relapsed into desert. In this condition the French found it, when their more scientific operations began. The first well sunk poured out a supply of a thousand gallons a minute, which formed a little river by itself, and the others, which were sunk in rapid succession, proved nearly as successful; so two years ago the Algerian portion alone of the district possessed six hundred and six wells, yielding more than sixty thousand gallons of water per minute, or about one-tenth the summer flow of the Seine at Paris. Most of these wells were sunk in the oases already existing, which they restored to their former fertility, but many were drilled in the desert itself, and new oases immediately sprang up around them. Dry and barren as is the desert soil, it produces vegetation abundantly as soon as it is moistened, and no sooner is a well opened than five to eight thousand palm-trees are planted around it and flourish admirably. It is hardly necessary to say that each of the new oases soon becomes a centre of population, and more than six thousand new inhabitants have already come to the district, while the annual value of its products has increased five-fold.

SAFE BUILDING.—XIX.[1]

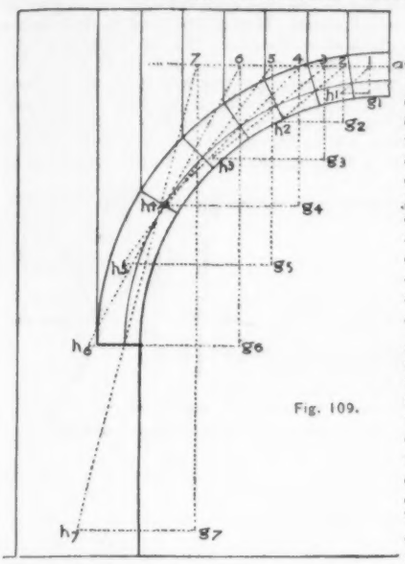


Fig. 109.

Example V.

A 12-inch brick semi-circular arch has 12 foot span. A solid brick wall is built over the arch to a level with one foot above the keystone. The abutment piers are 5 feet high to the spring of arch and are each 3 feet wide, including, of course, the width of skew-backs. Are the arch and piers safe?

Arch in fence-wall with abutment. As before, we will assume arch, pier, and wall over arch, each one foot thick. We will divide the load over arch into seven equally wide slices. This will make uneven voussoirs, but this does not matter, as our joint lines (and voussoirs) are only imaginary anyhow, and not necessarily of the shape of the actual voussoirs, which in brick would, of course, be represented by each single brick. The amount of the sums of each voussoir and its load, and the vertical neutral axis of the different sets are given by the arrows and lines G_1, G_2, G_3, etc. (in Fig. 110). When considering the safety of the abutment we treat it exactly the same as the voussoirs (and loads) of the arch; that is, we take the whole weight of the abutment, viz., C D E F I H C and find its neutral axis G_8.

Returning now to the arch, we go through the same process as before. We find the horizontal pressures (Fig. 109) $g_1 h_1$, $g_2 h_2$, etc. In this case we find that the last pressure $g_7 h_7$ is not as large as $g_6 h_6$; therefore we adopt the latter; it scales 1425 units or pounds. We now make (Fig. 110) $a\,o = 1425$ pounds; and $a\,b = 251$ pounds; $b\,c = 280$ pounds; $c\,d = 373$ pounds, etc.; $g\,h$ is equal to the last section of arch or 1782 pounds. We continue, however, and make $h\,i = 4600$ pounds = the weight of abutment. Draw $o\,a$, $o\,b$, $o\,c$, etc., to $o\,i$. Then get the tangents to the curve of pressure, as before, viz.: $a\,1\,i_1\,i_2\,i_3\,i_4\,i_5\,i_6\,K_7$; we now continue $i_6\,K_7$, which is parallel with $o\,h$ till it intersects the vertical axis G_8 of the abutment at i_7 and from thence we draw $i_7\,K_8$ parallel with $a\,i$.

Thrust on abutment. We will now examine the base joint I H of pier. I K_8 scales $10\frac{1}{2}''$, and as the pier is 36″ wide, K_8 is $7\frac{3}{4}''$ from the centre of joint. The area is $a = 12.36 = 432$ and the pressure is $p = o\,i = 9100$ pounds.

Therefore,

$$\text{Stress at I} = \frac{9100}{432} + 6.\frac{9100.7\frac{3}{4}}{432.36} = +48 \text{ pounds.}$$

and

$$\text{Stress at H} = \frac{9100}{432} - 6.\frac{9100.7\frac{3}{4}}{432.36} = -6 \text{ pounds.}$$

There is, therefore, a slight tendency for the pier to revolve around the point I, raising itself at H; still the tendency is so small, only 6 pounds per square inch, that we can safely pass the pier, so far as danger from thrust is concerned.

Joint C D at the spring of the arch looks rather dangerous, however, as $i_6\,i_7$ cuts it so near its edge D. Let us examine it. D K_7 measures $1\frac{1}{2}''$, therefore K_7 is $4\frac{1}{2}''$ from the centre of joint, which is 12″ wide. The area is, of course, $a = 12.\ 12 = 144$ and the pressure $p = o\,h = 4600$ pounds. Therefore,

$$\text{Stress at D} = \frac{4600}{144} + 6.\frac{4600.4\frac{1}{2}}{144.12} = +104 \text{ pounds.}$$

and

$$\text{Stress at C} = \frac{4600}{144} - 6.\frac{4600.4\frac{1}{2}}{144.12} = -40 \text{ pounds.}$$

It is evident, therefore, that the arch itself is not safe, and it should be designed deeper; that is, the joints should be made deeper (say, 16″), and a new calculation made.

Tie-rods to arches. If, instead of an abutment-pier, we had used an iron tie-rod, its sectional area would have to be sufficient to resist a tension equal to the greatest horizontal thrust $o\,a$; and care should be taken to proportion the washers at each end, large enough that they may have sufficient bearing-surface so as not to crush the material of the skew-backs.

Thus, in Example III, Fig. 105, if we should place the iron tie-rods to the beams 5 feet apart, they would resist a tension equal to five times the horizontal thrust $o\,a$, which, of course, was calculated for 1 foot only, or

$$t = 5.\ 2040 = 10200 \text{ pounds.}$$

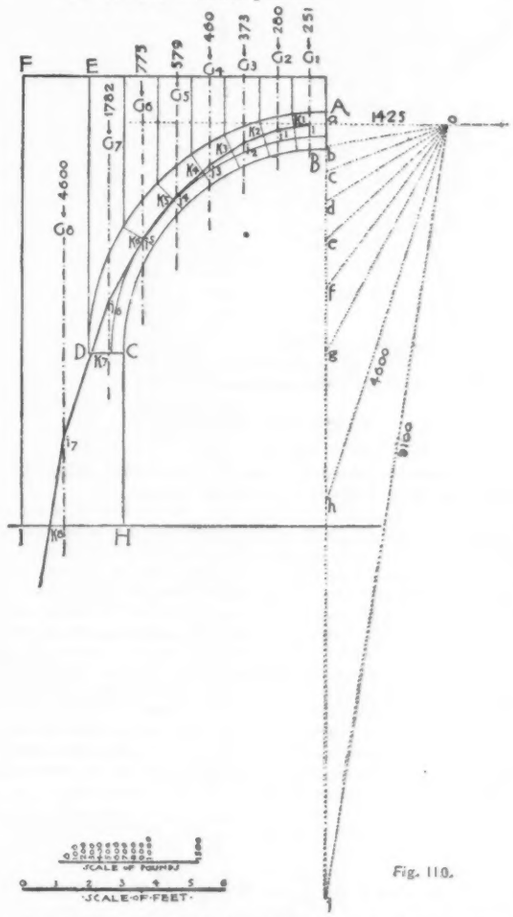


Fig. 110.

The safe resistance of wrought-iron to tension is from Table IV, 12000 pounds per square inch; we need, therefore:

$$\frac{10200}{12000} = 0{,}85 \text{ square inches}$$

of area in the rod; or the rod should be $1\frac{1}{16}''$ diameter. A 1″ or even $\frac{7}{8}''$ rod would probably be strong enough, however, as such small iron is apt to be better welded, and, consequently, stronger, and the load on the arch would probably be a "dead" one.

As the end of rod will bear directly against the iron beam, the washers need have but about $\frac{1}{4}''$ bearing all around the end of the rod, so that the nut would probably be large enough, and no washer be needed.

[1] Continued from page 161, No. 614.

GLOSSARY OF SYMBOLS.—The following letters, *in all cases*, will be found to express the same meaning, *unless distinctly otherwise stated*, viz.:—

a = *area*, in square inches.
b = *breadth*, in inches.
c = constant for *ultimate resistance to compression*, in pounds, per square inch.
d = *depth*, in inches.
e = constant for *modulus of elasticity*, in pounds-inch, that is, pounds per square inch.
f = *factor-of-safety*.
g = constant for *ultimate resistance to shearing*, per square inch, across the grain.
g_1 = constant for *ultimate resistance to shearing*, per square inch, lengthwise of the grain.
h = *height*, in inches.
i = *moment of inertia*, in inches. [See Table I.]
k = *ultimate modulus of rupture*, in pounds, per square inch.
l = *length*, in inches.
m = *moment or bending moment*, in pounds-inch.
n = *constant* in Rankine's formula for compression of long pillars. [See Table I.]
o = the *centre*,
p = the *amount* of the *left-hand re-action* (or support) of beams, in pounds.
q = the *amount* of the *right-hand re-action* (or support) of beams, in pounds.
r = *moment of resistance*, in inches. [See Table I.]
s = *strain*, in pounds.
t = constant for *ultimate resistance to tension*, in pounds, per square inch.
u = *uniform load*, in pounds.
v = *stress*, in pounds.
w = *load at centre*, in pounds.
x, y and z signify *unknown quantities*, either in pounds or inches.
δ = *total deflection*, in inches.
ρ^2 = *square of the radius of gyration*, in inches. [See Table I.]
$\mathfrak{d}$ = *diameter*, in inches.
$\mathfrak{r}$ = *radius*, in inches.
π = 3.14159, or, say, 3 1-7 signifies the *ratio of the circumference and diameter of a circle*.

If there are more than one of each kind, the second, third, etc., are indicated with the Roman numerals, as, for instance, a, $a_{\rm I}$, $a_{\rm II}$, $a_{\rm III}$, etc., or b, $b_{\rm I}$, $b_{\rm II}$, $b_{\rm III}$, etc.

In taking moments, or bending moments, strains, stresses, etc., to signify at what point they are taken, the letter signifying that point is added, as, for instance:—

m = moment or bending moment at *centre*.
$m_{\rm A}$ = " " " *point A*.
$m_{\rm B}$ = " " " *point B*.
$m_{\rm X}$ = " " " *point X*.
s = strain at *centre*.
$s_{\rm B}$ = " *point B*.
$s_{\rm X}$ = " *point X*.
v = stress at *centre*.
$v_{\rm D}$ = " *point D*.
$v_{\rm X}$ = " *point X*.
w = load at *centre*.
$w_{\rm A}$ = " *point A*.

Example VI.

A pier 28″ wide and 10′ high supports two abutting semi-circular arches; the right one a 20″ brick arch of 8′ span; the left one an 8″ brick arch of 3′ span. The loads on the arches are indicated in the Figure 111. *Is the pier safe?*

Uneven arches with central pier. The loads are so heavy compared to the weight of the voussoirs, that we will neglect the latter, in this case, and consider the vertical neutral axis of and the amount of each load as covering the voussoirs also; except in the case of the

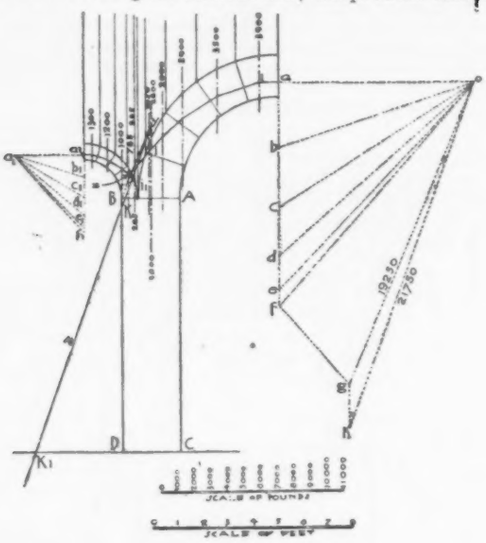


Fig. 111.

lower two voussoirs, where the axes are considerably affected. We find the curve of pressure of each arch as before.

For the large arch we would have the curve through *a* and *i*, for the small one through *a*, and *i*,; the points *i* and *i*, being the intersections of the curve with the last vertical neutral axis of each arch.

Now from *i* draw *i x* parallel with *o f*, and from *i*, draw *i*, *x* (backwards), but parallel with *o*, *f*, till the two lines intersect at *x*. Now make *f g* parallel with and = *o*, *f*,, and draw *g h* vertically = 2600 pounds = the weight of the pier from the springing line to the base (1′ thick). Draw *o g* and *o h*. Now returning to *x*, draw *x y* parallel with *g o* till it intersects the neutral axis of the pier at *y*, and from *y* draw *y Z* parallel with *o h* till it intersects the base joint C D of pier (or its prolongation) at K_1. Continue also *x y* till it intersects the springing joint A B and *K*. Now, then, to get the stresses at joint A B we know that the width of joint is 28″, therefore *a* = 28.12 = 336; further *p* = *o g* = 19250 pounds, and as *B K* scales one inch, *K* is distant 13″ from the centre of joint, therefore

$$\text{Stress at B} = \frac{19250}{336} + 6.\frac{19250.\ 13}{336.\ 28} = +\ 217 \text{ pounds.}$$

and

$$\text{t} \quad \text{at A} = \frac{19250}{336} - 6.\frac{19250.\ 13}{336.\ 28} = -\ 102 \text{ pounds.}$$

Thrust on central pier. The arch, therefore, cannot safely carry such heavy loads. The pier we shall naturally expect to find still more unsafe, and in effect have, remembering that joint D C is 28″ wide, therefore, area 336 square inches, and as K_1 distant 54″ from centre of joint, and *p* = *o h* = 21750 pounds.

$$\text{Stress at D} = \frac{21750}{336} + 6.\frac{21750.\ 54}{336.\ 28} = +\ 813 \text{ pounds.}$$

and

$$\text{Stress at C} = \frac{21750}{336} - 6.\frac{21750.\ 54}{336.\ 28} = -\ 684 \text{ pounds.}$$

Relief through iron-work. The construction, therefore, must be radically changed, if the loads cannot be altered. If the arches are needed as ornamental features, they should be constructed to carry their own weight only, and iron-work overhead should carry the loads, and bear either nearer to, or directly over, the piers, as farther trials and calculations might call for. If this is done the wall **To avoid cracks.** should be left hollow under the end of iron-work until it gets its "set"; that is, until it has taken its full load and deflection; and then the wall should be pointed with soft "putty" mortar.

Example VII.

The foundations of a building rest on brick piers 6′ wide and 18′ apart. The piers are joined by 32″ brick inverted arches and tied together 8′ above the spring of the arch. Piers and arches are 3′ thick. Load on central piers is 72 tons; on end pier 60 tons. Is this construction safe?

Inverted arches. We will first examine the inner or left pier. The pier being 3′ thick and the load 72 tons, each 1′ of thickness will, of course, carry $\frac{72}{3}$ = 24 tons. The width from centre to centre of piers is just 24′, so that each running foot of ground will receive a pressure of one ton. Now all we need to do is to imagine this pressure as the load on the arch. We can either draw the arch upside down with a load of one ton per foot, or we can make the drawing with the arch in correct position and the weights pressing upward, as shown in Fig. 112. We divide the load in five equal slices, each about 2′ wide, therefore = 2 tons each. **Strength of arch.** We make *a b* = 2 tons; *b c* = 2 tons, etc., and find the horizontal pressures $g, h_1, g_2 h_2$, etc., same as before. Again, $g_5 h_5$

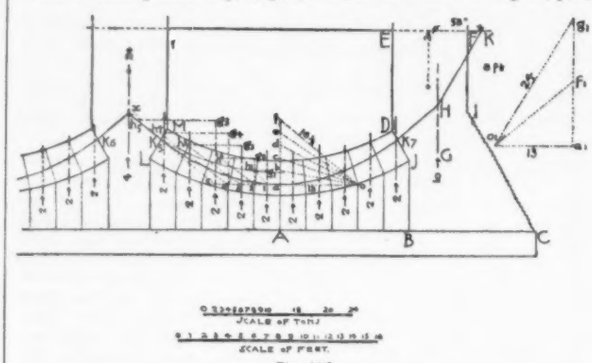


Fig. 112.

is the largest, measuring 13 units or tons. Now make *o a* = 13 tons, and draw *o b*, *o c*, etc. Construct the line *a* 1 K_5 or curve of pressure same as before. Joint L M is evidently the most strained one. We find M K_5 measures 11″, and as the arch is 32″ (= M L), of course, K_5 is 5″ from the centre of joint. The area of joint is *a* = 32. 12 = 384. We scale *o f*, the pressure at K_5, and find that it measures 16½ units, or 33000 pounds, therefore

$$\text{Stress at M} = \frac{33000}{384} + 6.\frac{33000.\ 5}{384.\ 32} = +\ 168 \text{ pounds.}$$

$$\text{Stress at L} = \frac{33000}{384} - 6.\frac{33000.\ 5}{384.\ 32} = +\ 6 \text{ pounds.}$$

Central pier. The arch, therefore, is perfectly safe. Of course, the left pier is safe, for being an inner pier the resistance K_6 *x* of the adjoining arch to the left will just counter-balance the thrust of our arch, or K_5 *x*. But at the end (right) pier this is different. We, of course, proportion the length of foundation A C, to get same pressure as on rest of ground. The end pier carries 60 tons, or $\frac{60}{3}$ = 20 tons per foot thick. The pressure per running foot on ground we found to be one ton, therefore A C should be 20 **Thrust on end pier.** feet long. The half-arch will take the pressure of 10 feet (from A to B) or 10 tons, and the balance (10 tons) will come on B C. This will act through its central axis G H, which, at the arch skew-back, will be half-way between the end of arch J and outside pier-line I F. This will, of course, deflect somewhat the abutment (or last pressure) line K_7 H of the arch. At any convenient place draw *a*, *f*, vertically equal 10 tons, and *a*, *o*, horizontally equal 13 tons, the already known horizontal pressure. Then K_7 H is, of course, parallel with and equal *o*, *f*,. Now make *f*, *g*, = 10 tons and draw *o g*. Now on the pier draw H K parallel with *o*, *g*,; H being the point of intersection of G H and K_7 H. As the pier is tied back 8′ above the arch, we take our joint-line at E F, being 8′ above D. We find, by scale, that *K* is 58″ from the centre of E F, the latter being 72″ wide. The area is *a* = 72. 12 = 864. And as *o*, *g*, scales 24 units, the pressure is, of course, 24 tons or 48000 pounds, therefore:

$$\text{Stress at F} = \frac{48000}{864} + 6.\frac{48000.\ 58}{864.\ 72} = +\ 315 \text{ pounds.}$$

and

$$\text{Stress at E} = \frac{48000}{864} - 6.\frac{48000.\ 58}{864.\ 72} = -\ 207 \text{ pounds.}$$

Use of buttress. There is, therefore, no doubt of the insecurity of the end pier. Two courses for safety are now open. Either we can build a buttress sufficiently heavy to resist the thrust of the end arch, or we can tie the pier back. The former case is easily calculated; we simply include the mass of the buttress in the resistance and shift the axis G H to the centre of gravity of the area of pier and buttress up to joint E F. Of course, the buttress should be carried up to the joint-line E F, but it can taper away from there.

Use of tie-rods. If we tie back with iron we need sufficient area to resist a tension equal to the horizontal pressure *a o*, which in this case is 13 tons or 26000 pounds per foot thick of wall. As the wall is 3′ thick, the total horizontal thrust is 3. 26000 = 78000 pounds. The tensional stress of wrought-iron being 12000 pounds per square inch, we need $\frac{78000}{12000}$ = 6½ square inches area, or, say, two wrought-iron straps, 4″ x ⅞″, one each side of pier. By this method the inner or left arch becomes practically the end arch. For the last two piers and the right arch become one solid mass; and not only is their entire weight thrown against the second or inner arch, but the centre of gravity of the whole mass shifts to the centre line of end

arch, or in our case 9′ *inside* of the end pier; so that there is no possible doubt of the strength of the abutment. There is one element of weakness, however, in the small bearing the pier has on the skew-back of the arch, the danger being of the pier cracking upwards and settling past and under the arch. This can be avoided, as already explained, by building a large bond-stone across the entire pier, forming skew-backs for the arch to bear against.

Example VIII.

A semi-circular dome, circular in plan, is 40′ inside diameter. The shell is 5′ thick at the spring and 2′ at the crown. The dome is of cut-stone. Will it stand?

Calculation of dome. We draw a section (Fig. 114) of the half-dome and treat it exactly the same as any other arch. The only difference is in the assumption of the weights. Instead of assuming the arch 1′ thick, we take with each voussoir its entire weight around one-half of the dome. Thus, in our case, we divide the section into six imaginary voussoirs. The weight on each voussoir will act through its centre of gravity. Now weight No. I will be equal to the area of the top voussoir multiplied by the circumference of a semi-circle with A B as radius. Similarly, No. II will be equal to the area of the second voussoir multiplied by the circumference of a semi-circle with A C as radius; No. III will be equal to the area of voussoir 3, multiplied by the circumference of a semi-circle with A D as radius, etc. The vertical neutral axes Nos. I, II, III, etc., act, of course, through the centres of gravity of their respective voussoirs. Now the top voussoir measures 5′ 6″ by an average thickness of 2′ 1″ or 5½. $2\frac{1}{12} = 11{,}46$ or, say, 11½ square feet.

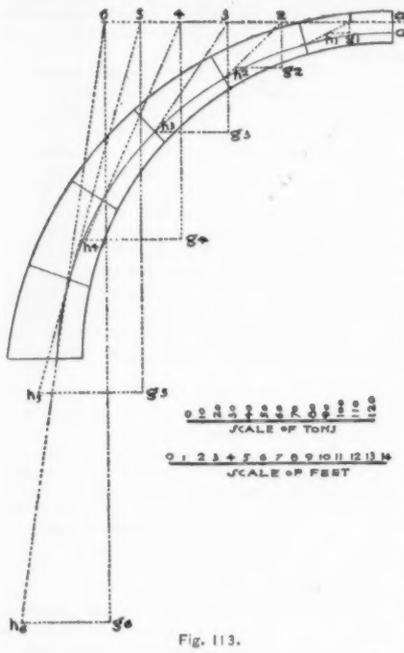


Fig. 113.

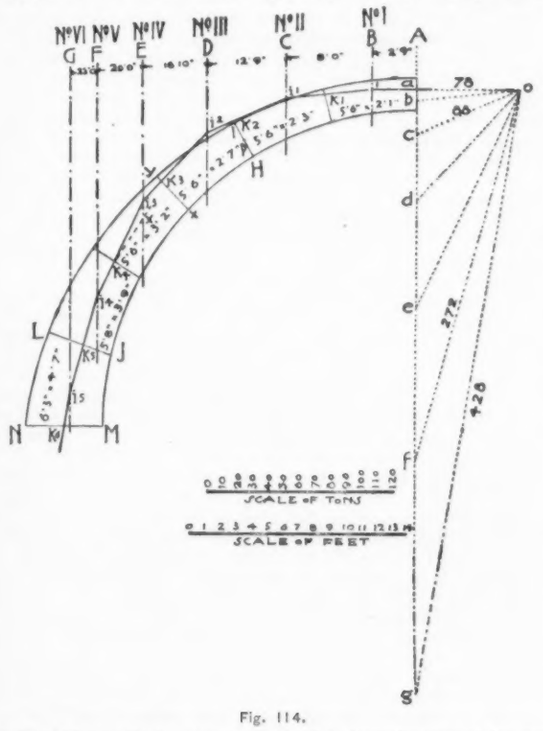


Fig. 114.

As A B (the radius) measures 2′ 9″, the circumference of its semi-circle would be 4½′. Taking the weight of the stone at 160 pounds per cubic foot, we should then have the weight of No. I = 11,5. 8, 6. 160 = 15824 pounds, or, say, 8 tons.

Similarly we should have:

No. II = 12,4. 25,1. 160 = 49798 pounds, or, say, 25 tons.
No. III = 14,2. 40. 160 = 90880 " " 45 "
No. IV = 17,4. 52,7. 160 = 146716 " " 73 "
No. V = 21,2. 62,8. 160 = 213017 " " 106 "
No. VI = 28,7. 69,1. 160 = 317307 " " 158 "

We now make $a\,b = 8$ tons, $b\,c = 25$ tons, $c\,d = 45$ tons, $d\,e = 73$ tons, $e\,f = 106$ tons and $f\,g = 158$ tons. We find the horizontal pressures g, h_1, g_2 h_2, etc. (in Fig. 113), same as before. In this case we find that the largest pressure is not the last one, but g_5 h_5 which measures 78 units; we therefore select the latter and (in Fig. 114) make $a\,o = g_5\,h_5 = 78$ tons. Draw $o\,b$, $o\,c$, $o\,d$, etc., and construct the line a 1 i_1 i_2 i_3 i_4 i_5 K_6, same as before. In this case we cannot tell at a glance which is the most strained voussoir joint, for at joint H I the pressure is not very great, but the line is farthest from the centre of joint. Again, while joint J L has not as much pressure as the bottom joint M N, the line is farther from the centre. We must, therefore, examine all three joints.

We will take H I first. The width of joint is 2′ 5″ or 29″. The pressure is $o\,c$, which scales 88 tons or 176000 pounds. The distance of K_2 from the centre of joint P is 16″. The area of the joint is, of course, the full area of the joint around one-half of the dome, or equal to H I multiplied by the circumference of a semi-circle with the distance of P from $a\,g$ as radius. The latter is 10′ 6″, therefore area $= 2\frac{5}{12}$. 16,5 = 40 square feet or 5760 square inches, therefore:

$$\text{Stress at I} = \frac{176000}{5760} + 6.\frac{176000.\,16}{5760.\,29} = +131{,}7$$

$$\text{Stress at H} = \frac{176000}{5760} - 6.\frac{176000.\,16}{5760.\,29} = -70{,}5$$

For joint J L we should have: the width of joint = 50″. The pressure $= o\,f = 272$ tons or 544000 pounds. The distance of K_5 from the centre of joint is 8″, while for the area we have 50. 33⅓. 12 = 20000 square inches, therefore:

$$\text{Stress at J} = \frac{544000}{20000} + 6.\frac{540000.\,8}{20000.\,50} = +53 \text{ pounds.}$$

and

$$\text{Stress at L} = \frac{544000}{20000} - 6.\frac{540000.\,8}{20000.\,50} = +1 \text{ pound.}$$

For the bottom joint M N we should have the width of joint = 60″. The pressure $= o\,g = 428$ tons or 856000 pounds. The distance of K_6 from the centre of joint is 4″, while for the area we have 60. 35⅓. 12 = 25440 square inches, therefore:

$$\text{Stress at M} = \frac{856000}{25440} + 6.\frac{856000.\,4}{25440.\,60} = +47 \text{ pounds.}$$

and

$$\text{Stress at N} = \frac{856000}{25440} - 6.\frac{856000.\,4}{25440.\,60} = +20 \text{ pounds.}$$

The arch, therefore, would seem perfectly safe except at the joint H I, where there is a tendency of the joint to open at H. Had we, however, remembered that this is an arch, lightly loaded, and started our line at the lower third of the crown joint, instead of at the upper joint, the line would have been quite different and undoubtedly safe.

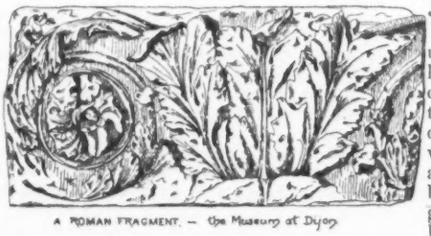
The dangerous point K_2 in that case would be much nearer the centre of joint, while the other lines and joints would not vary enough to call for a new calculation, and we can safely pass the arch. One thing must be noted, however, in making the new figure, and that is that the horizontal pressures g, h_1, g_2 h_2, etc. (in Fig. 113), would have to be changed, too, and would become somewhat larger than before, as the line a, 6 would now drop to the level of a_2. A trial will show that the largest would again be g_5 h_5, and would scale 80 units or tons, which should be used (in Fig. 114) in place of $a\,o$.

LOUIS DECOPPET BERG.

[To be continued.]

MUNICIPAL GRIEVANCES.

"And the wickedness of a soul is ignorance." — *The Divine Pymander.*



A ROMAN FRAGMENT. — the Museum at Dijon

THAT the American citizen is patient under grievances, long suffering under injury, is a fact too patent to need demonstration, yet we were astonished at being told so by our late distinguished guest, Herbert Spencer.

Of whom are our municipal governments and State legislatures composed? What does the successful money-getter know about the sanitary rules which should be considered in making laws for a great city? The power to grant charters for so-called public improvements should be made by men *éclairé* and belonging, in majority, to the liberal professions, especially to that of medicine. No charters should be granted to companies without due deliberation and a

conviction that their action will be for the greatest good to the greatest number. The first axiom of American stock companies is that people are made for stock companies, not stock companies to minister to the public. The public is regarded as a cow to be milked for these companies, and it matters not what the effect of their contrivances is on the public health. Every possible outrage may be committed in the name of a stock company, and the public has no rights a company is bound to respect. This is called progress. Liberty, both collective and individual, is throttled. Herbert Spencer says, "The Americans retain the forms of freedom, but so far as I can gather there has been considerable loss of the substance." The man who could free the country from the grasp of corporations would be a second Washington. Above all, the charters issued to companies to use the public highways should be in the interest of the majority. Take, for example, the public steam-heating companies; it is in no wise in the interest of the general public that these charters have been obtained. Public steam-heating, radiating from a central station, has been anything but a public benefit, the advantage, if there be any, being confined to a limited number of persons outside of the company. The first effect is to melt the frost and snow on the side of the street where the pipes are located, and to make a river of slush, while the other side is an inclined plane by the progressive action of the heat. Thus pleasant or safe driving is rendered impossible. The steam, which is seen rising from around the centres of the man-holes, gives one the impression of being in a country of partially-extinct volcanoes or geysers, and many runaway horses are the result.

Several New York physicians testify that the steam companies' excavations have produced "a considerable amount of malarial disease of a severe character." It is to be hoped that the high-handed usurpations of the steam-heating companies will meet its Waterloo before all our roadways are converted into hot-beds or nurseries of malaria by steam-heating appliances. The mud of cities is composed largely of dangerous filth. In the winter nature provides that the germs of disease, more or less included in this filth, should be inert from the action of cold. This benevolent intention of nature is rendered abortive by steam-pipes, the heat drying the dirt, and the winter winds disseminating it about the streets and in our houses. If our streets were properly paved, with lava or cemented blocks of stone, this evil would not be so great. Inside of the man-holes is a large iron bulb or steam-chamber, kept at a very high temperature. In the hollow space surrounding it settles a quantity of filthy water, the draining of the street. This is kept in a perpetual state of ebullition, and it is from this dangerous water that the steam is seen rising. When the man-holes are filled, they are baled out at night, the companies being, probably, ashamed to allow the public to witness the operation by daylight. The foul water is turned into the gutters, where it may become a source of disease. The noxious odor from this fetid water is conveyed by the large wooden pipes, in which the small iron steam-tube is enclosed, into the cellars of houses and thence distributed as a "modern convenience" throughout the mansion to enrich, later, doctors and undertakers. Besides the more or less intense heat, steam is disengaged from the apparatus into the cellar by leakage, etc. Unless the floor of the cellar is thoroughly cemented, the heat must call forth the ground air. Besides these difficulties is the possibility of explosion. In several instances, the iron disc covering the man-hole has been thrown into the air, injuring passers-by.

Whatever may be said in favor of private steam-heating, the warming of buildings from a common central apparatus is an unwarrantable and flagrant violation of the rights of a majority, designed to benefit a few at the expense of the health and convenience of the many. When will legislators learn that the highways of a city belong to the people, and that they have no right to give charters to any company that interferes with the health and convenience of the frequenters of a highway. If majorities govern, the number of promenaders using a street is greater than the number of persons supposed to be benefited. Our rights as a people are constantly disposed of by our city and State governments, from the wicked alienation of our fair lands at the far west, to the charters won by bribery from our boodle aldermen. The perpetual repairing of the steam-pipes, the upturning of the streets consequent thereupon, as well as during the original installation, distributing malaria from the upturned ground, is an unwarrantable infringement of human rights, for which no legislature or city council ought to give a charter. The millennium may come, but it will never be possible to put heat, moisture and dirt together without harmful bacteria. Tropical heat, moisture and filth will produce the same effect in a great city as in a South American jungle.

Nor is the present system of electric-lighting in America safe from indictment. There is no reason for allowing the streets to be disfigured with poles forty feet in height with a blinding light at the summit, which brightens or decreases in a manner trying to the eyesight. These flickering or uneven lights are a torment to many persons in their vicinity. Nature means the night for silence and repose. There should be enough artificial light to see one's way perfectly, but not enough to turn night into day. The defects of our cities, the dirt and ill-kept walks, are covered at night by the charitable veil of a semi-obscurity, and, even on that account, an evening walk has its charms. Sunshine and shadow should succeed each other and the rights of the moon should be respected. The changes from day to night are necessary to health and happiness, or nature would not have instituted them. She puts out and draws in her forces with an eternal rhythm. Large lights have their place on the railroad depots, or on the parks, and on trans-Atlantic steamers, but for the street they should be no larger than those used in stores, and absolutely free from wires or any disfiguring apparatus. Why do not the electric companies study the system of electric-lighting in Paris known as the Jablochkoff system? The electric iron lamp-posts in Paris are scarcely higher than our street gas-lamps, artistic in model, and the light mellowed by ground-glass shades. No wires or other apparatus are visible. We lose, in over-lighted thoroughfares, the mysterious beauty of the night and the repose it brings to the spirit worn with the toils of the day.

The same disregard of the public rights is shown in granting permission to telephone companies to place their disgraceful-looking wires on everybody's houses, with or without permission, often the latter, till the city appears to be covered with a gigantic spider's web. The ugly-looking poles disfigure the streets, while storms shatter wires and poles to the danger of public travel. Many of these telephones are of no greater utility than for affluent families to order their beefsteaks and groceries, articles which, in these days of adulteration, would be much better bought after personal inspection. It may be well enough to erect great poles for telegraphs and telephones on country roads and in small towns, but they are clearly out of place in great cities. Neither is the proposition to bury them much better, as that necessitates more digging up of the streets, more malaria therefrom, and more inconvenience to the already long-suffering denizens of the city. In large cities, the main sewers should pass through subterranean streets, properly sidewalked, and lighted with gas, while along its sides should be placed the gas-pipes, water-mains, and telegraph-wires, just as in Paris. If we refuse to take this trouble, necessary to the well-being of our cities, the telegraph-poles should cease at the outskirts of the city, where the principal office might be located, and despatches sent to and from the office by bicyclists. The telegraph nuisance might be abated somewhat by raising the price and confining it principally to business houses.

Still more objectionable are elevated railroads. A judicious ceinture road running round New York, with surface-cars propelled by electricity, from the circumference to the principal streets, would have been much better. The disfiguring scaffolding and the noise and darkness that elevated roads make are too much of an annoyance to be tolerated. What sort of nervous constitutions will the human beings born and brought up amid the ceaseless din of elevated railways possess? In any case, the charters for elevated roads and steam-heating are ones no city government has any right to give without the votes of the townspeople, and some other plan than elevated railroads should be devised to meet the demands for rapid transit. Even cars running by electricity on the old tramways would have been preferable, the railroad being enclosed by an iron fence, and crossings at certain intervals could have been made by inclined planes over or under the railway. Cars and roads can be so constructed as to run with much less noise, as is the case in Continental countries. The danger of locomotion in the air is not the least of the objections to elevated roads. The greatest is the effect on the nervous constitutions of the people who live along the line.

The principles of government as laid down by the constitution of the United States and the Declaration of Independence are assuredly the noblest ever inscribed in any constitution, but the real, only liberty now remaining to us is that any one can put his hand in his neighbor's pocket, and that great corporations, which make a monopoly of everything we eat and drink and wear, may be formed to fleece the public, already shorn to the last lock. The consequence of all this is that living is dearer in the United States than in any civilized country in the world. Of real liberty we have none. Only the poor privilege, denied in foreign countries, remains, that of anathematizing and abusing the government—a small compensation for the real liberty we have lost. Our filthy, ill-kept streets, destitute of anything like adequate pavement, our want of proper machines for cleaning them, the painful economies in the most important sanitary matters, while our boodle law-makers drink champagne at the tax-payer's expense, bear witness to the truth of what I say. There is one thing worse than effete monarchies and that is effete peoples and an effete public such as most of our great cities present.

Hartford is, perhaps, a case in point. Right through the centre of the city courses a narrow, sluggish stream, now an open sewer, which would disgrace mediæval times, and such is the want of sanitary knowledge that a mill-owner, to whom in ancient times the city sold the right to draw off the water, still does so almost nightly for milling purposes, leaving the wind to distribute, from its reeking banks and bed, the millions of seeds of typhoid-fever, scarlet-fever, and dissolved diphtheria membranes among the population when asleep and in the negative condition favorable to inception of contagious diseases. The city cannot afford to rectify this state of affairs, but could afford to pay $150,000 for a soldiers' monument, which stands at the side and presides over this open sewer, and which should do honor, not only to the patriotic victims of the war, but to the still larger number of citizens, though no inscription records their fate, who have succumbed yearly to the attacks of their invisible and innumerable foes cultured in this sewer. Mark Twain, who addressed the veterans of the Grand Army of the Republic in Hartford three years ago, intimated that though great honor was due to the brave men who went to the war, perhaps even more was due to

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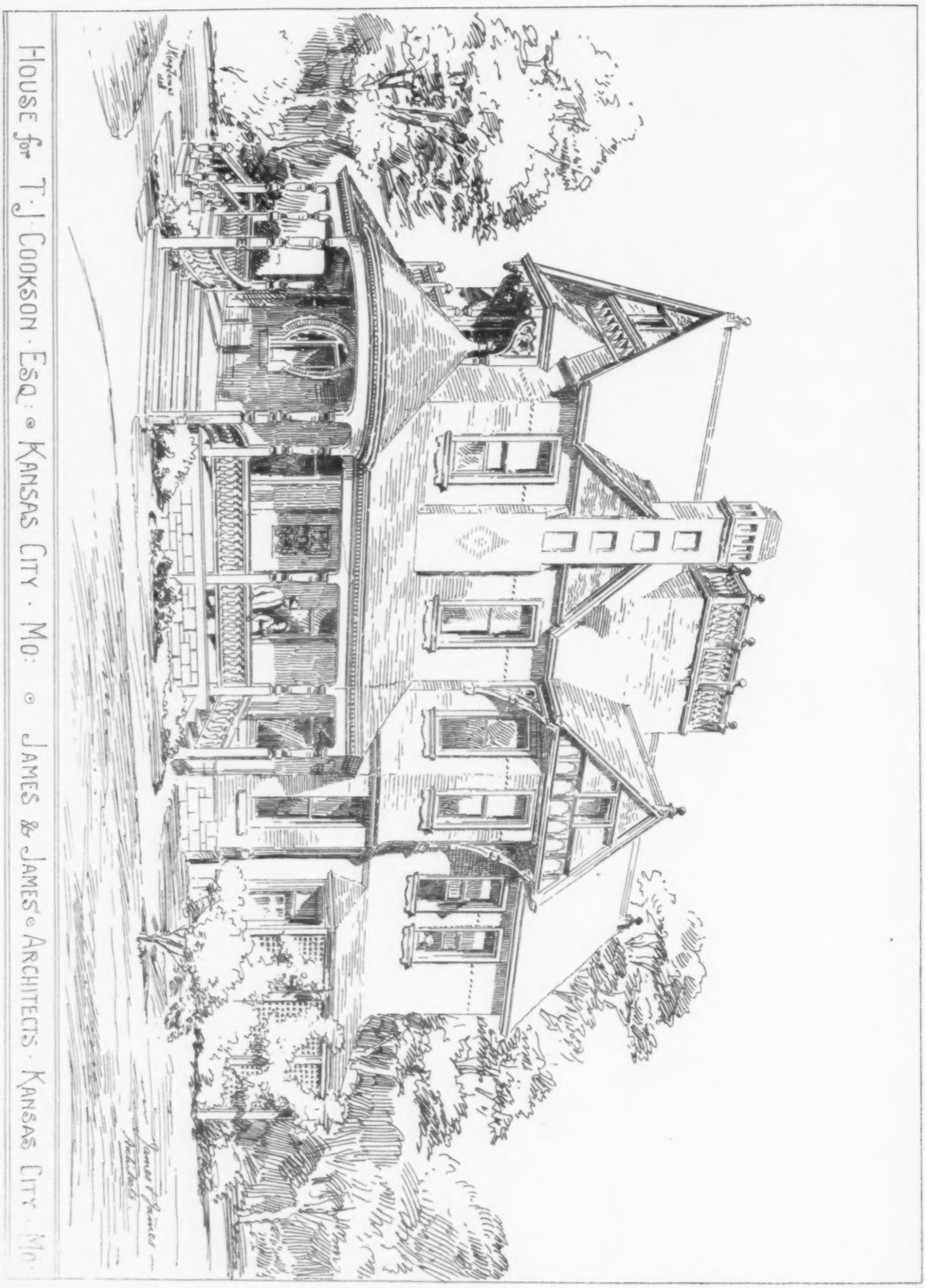

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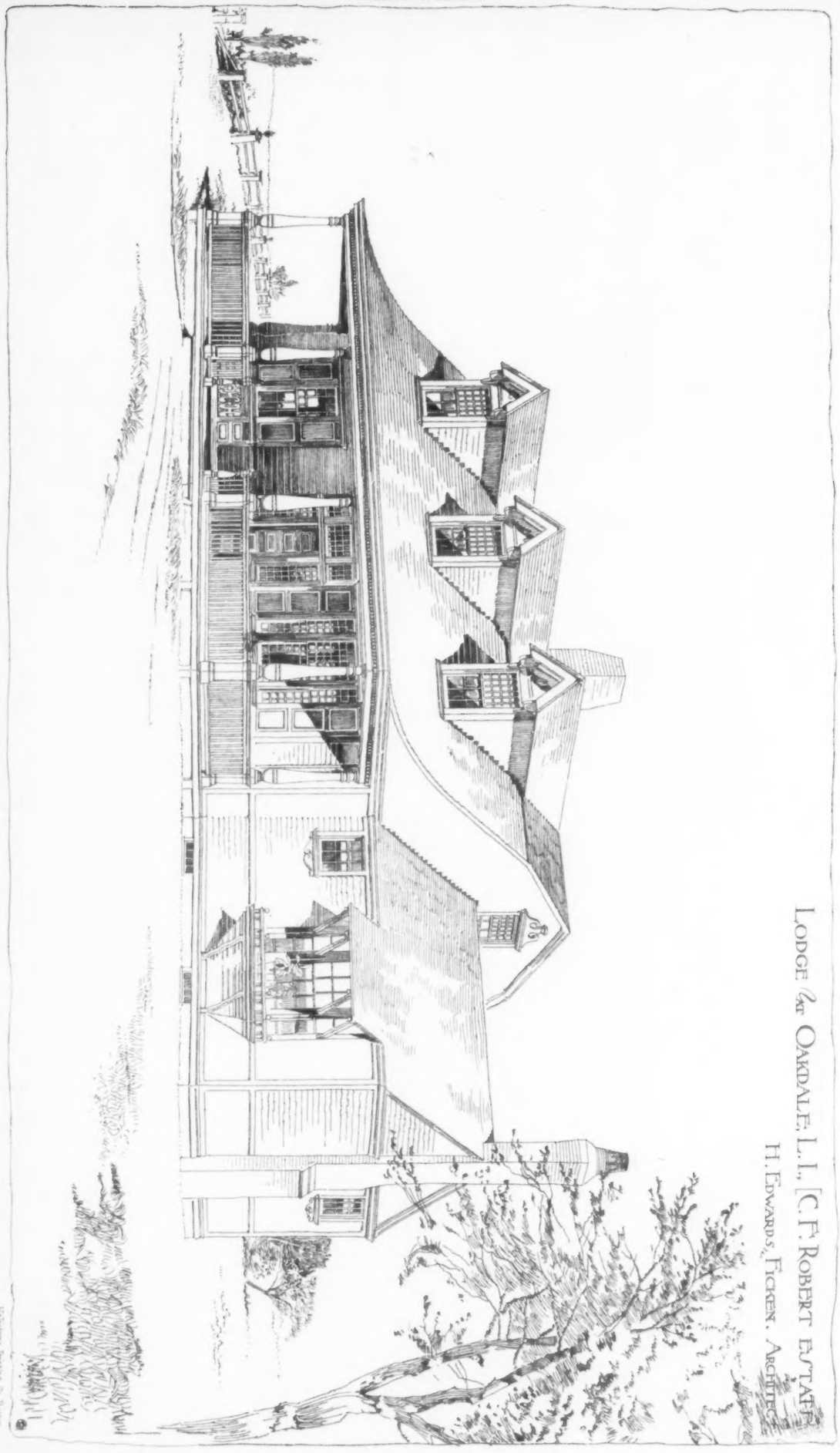

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CHURCH OF THE SACRED HEART

DAYTON, OHIO

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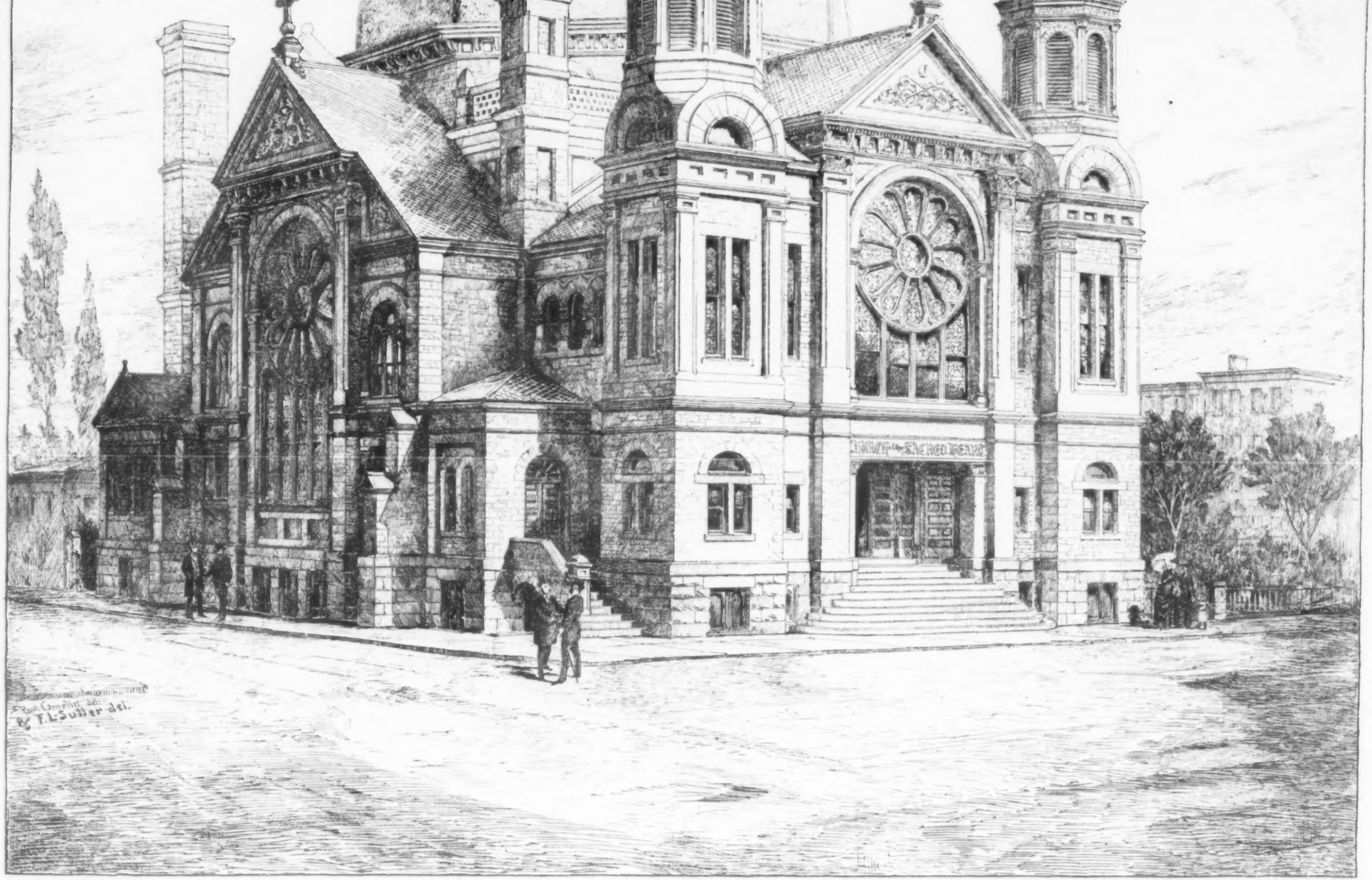
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Houses on
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Lamb and Rich Architects

Residence of
Mrs Harriet N Andrews

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those who remained at home and risked their lives daily, as he did, in passing Park River sewer. Statistics show that only ten per cent of those who go to war perish by lead, while in Hartford, in July, 1887, the mortality of this city of 50,000 encamped around an open sewer was thirty-seven per thousand, showing a murderous loss of life, since Chadwick, the sanitary father of Great Britain, says "cities can reduce their mortality to five per thousand." The village, of more than 1,500 model houses for the working classes, built by the late earl of Shaftesbury at Clapham, near London, shows a mortality of only twelve per thousand, showing how sanitary surroundings can affect the death-rate. The garbage in this not model city of the Puritans, Hartford, is also unhealthfully disposed of by a private company, which throws it onto certain low-lying city lands, which later will be building-lots, instead of consuming it, as should be done, in a rubbish furnace similar to the one used with great success in Leeds, England, which would cost the city only a moderate sum and decrease the taxes of the tax-payers for the hospital and poor-house.

The object intended to be emphasized in this essay is that the thoroughfares, streets and even lanes of a city or town belong to the sovereign people; that no one has a right to dispose of any part of them in the interest of a few favored ones against safe, easy, and commodious transit, or in any way to offend even the artistic perceptions of its frequenters. It should, on the contrary, be the pride and delight of all the dwellers of a city to keep its thoroughfares in as perfect order as possible, that we may love our abiding-place as the ancient Romans loved the Eternal City and as the Parisians of to-day love Paris.

SARAH GILMAN YOUNG.

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

BUILDING OF THE STANDARD LIFE ASSURANCE ASSOCIATION, MONTREAL, P. Q. MR. R. A. WAITE, ARCHITECT, BUFFALO, N. Y.

[Gelatine Print, issued only with the Imperial Edition.]

HALL OF SCIENCE, HAMLINE UNIVERSITY, ST. PAUL, MINN. MR. WARREN H. HAYES, ARCHITECT, MINNEAPOLIS, MINN.

THIS structure is now being roofed, and will be occupied for the winter term. The walls are faced with a sand-moulded red brick laid in chocolate-colored mortar and relieved with brown sandstone from Bayfield, Lake Superior. Roof of black slate. Interior finish of oak and other native woods finished on the natural grain. Cost of building complete, $45,000, including heating and plumbing.

HOUSE OF T. J. COOKSON, ESQ., KANSAS CITY, MO. MESSRS. JAMES & JAMES, ARCHITECTS, KANSAS CITY, MO.

THE first story of this house is of brick, the second is shingled, and the roof is covered with "Cortland" steel plates.

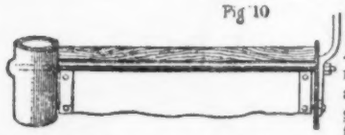
LODGE FOR C. F. ROBERT'S ESTATE, OAKDALE, LONG ISLAND, N. Y. MR. H. EDWARDS-FICKEN, ARCHITECT, NEW YORK, N. Y.

CHURCH OF THE SACRED HEART, DAYTON, O. MR. C. I. WILLIAMS, ARCHITECT, DAYTON, O.

HOUSES ON WEST SEVENTY-FIRST STREET, NEW YORK, N. Y. MESSRS. LAMB & RICH, ARCHITECTS, NEW YORK, N. Y.

IRON STAIRCASES.[1]

Fig 10



STAIRCASES serve as a means of communication between the several stories in a building. They are a succession of steps, or grades, supported by, and framed into, one another on the slant, and consist of a horizontal part called foothold or tread, and of a horizontal part, the riser.

Of the Foothold. — In straight staircases, the breadth of the step taken midway between the extremities is the foot-print. In balanced staircases, or such as have dancing-steps exceeding one metre in length, the breadth of tread or foot-print must be taken parallel to the horizontal projection of the hand-rail at fifty centimetres distance therefrom. The line formed by the successive foot-prints is called the line of traffic. This distance of fifty centimetres from the hand-rail represents the position of a person ascending or descending and holding the rail.

Balancing. — The breadth of the treads in their curved or straight portions is arrived at by making a drawing on the floor or wall. First, the number of dancing-steps or winders deemed indispensable is determined, and then the minimum dimension of the smallest inner angle. In the next place, the compasses are brought into requisition to settle the measurement of the tread in the centre, gradually decreasing the opening until it equals the measurement of the smallest inner angle, taken as a starting-point. It is by a tentative process, rendered easy by practice, that the best result is obtained. Geometrical methods are hardly ever resorted to.

Height and Breadth of the Steps and Landings. — The height and breadth of the steps are very variable quantities, generally subject

Fig 1

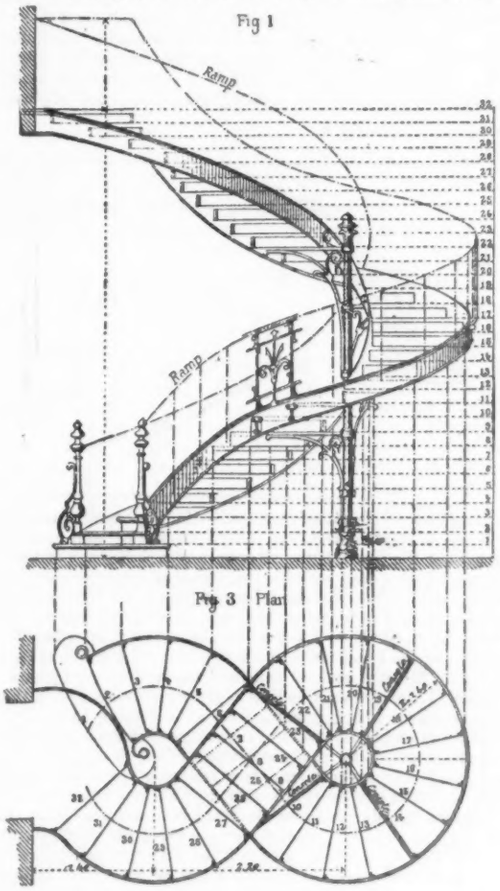
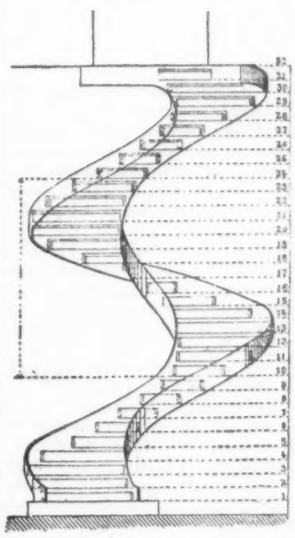


Fig 3 Plan

to the exigencies of the space reserved for a staircase. As a rule, the broader the tread at the line of traffic, the less ought to be the riser or the height of a step. The breadth of the tread varies from 23 to 40 centimetres, and the height of the risers from 11 to 19 centimetres, a maximum and minimum that should never be exceeded. The most ordinary dimensions are from 25 to 35 centimetres for breadth, and about 16 centimetres for height. Within these limits stairs are always easy of ascent and not tiring. On the ground floor it is usual to allow more breadth for the first three steps; for the first step, an extra 3 centimetres; for the second, 2 centimetres; for the third, 1 centimetre extra. Thus, for instance, in a staircase of which the breadth of tread is equal to 30 centimetres, the first step will be 33, the second 32, and the third 31 centimetres. Where we are not obliged to observe fixed dimensions in the staircase cage and in the height of ascent in getting out plans, the step may be set down as $2\,h. + b = 60$ to 66 centimetres, or twice the height and once the breadth equal 60 to 66 centimetres, a formula that works out well. An ordinary staircase to be convenient should be kept to a pitch ranging from 24° to 30°. It should consist of steps uniform in height, at least, in each flight or difference of level between the floors of each story, measured from flooring to flooring. The landings should be 80 centimetres broad as a minimum, and in any case not fall short of the sum of three steps measured horizontally at centre of the tread. This remark

Fig 2



[1] From "*Nouvelles Annales de la Construction.*"

applies particularly to back stairs and small staircases, where space is limited. Speaking generally, landings should be made as broad as possible.

Character and Dimensions of Stairs.—Steps are made in chequered masonry, cement, etc., of fir, pitch-pine, beech (rarely), stone, marble and iron. Thicknesses for wooden steps in staircases vary from 27 to 54 millimetres. In large staircases, such as we find in railway stations, for instance, the thickness of the tread attains to as much as 7 centimetres (planing will reduce it by 3 to 4 millimetres). The thickness in the case of stone or marble varies from 6 to 8 centimetres. However, in staircases not exposed to rough usage, marble slabs may be used as thin as 3 centimetres as a minimum, provided they be fairly and squarely placed on a bed of plaster.

Fig 4

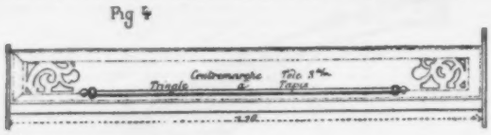


Fig 5

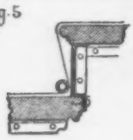


Fig 6

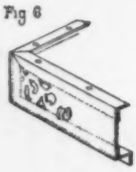
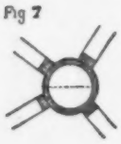
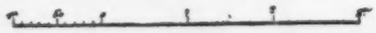


Fig 7





Head-Room or Height of Passage.—An important question in the construction of staircases, and which should be well considered in working out the plans, is the allowance of a sufficiency of head-room. In stairs of the most usual style, those of the ordinary dwelling-house let out in flats, we must bear in mind: 1. The head-room in the stairs leading down to the cellars. Fourteen steps are required as a minimum, to allow 2 metres for the cellar door, a height which, according to the importance of a house and its destined uses, may be reduced to 1 metre and 80 centimetres, or even to 1¾ metres. 2. The ground floor, always having a greater elevation than the other stories, requires a larger number of steps, which can only be provided by advancing the point of departure to make up the difference, the consequence being that the landing of the first story must stand over the sixth or seventh step, thus reducing the head-room by that much. Now, to get over this difficulty, we may increase the height of the steps in order to lessen their number, and thus bring the landing over the third or fourth steps. The steps of the first revolution may, without disadvantage, be increased in height by 8 to 10 millimetres, and it is more particularly in the upper stories that the rise of the steps should be kept down as much as possible. The head-room should not fall short of 2 metres and 20 centimetres; below this height the moving of the furniture is apt to spoil the ceiling. The starting-point of a staircase should be placed beneath the first-floor landing.

Fig 8

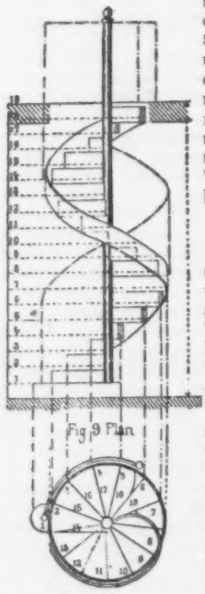


Fig 9 Plan

VARIETIES OF STAIRCASES.

The "Miller's Steps."—This style of stair is simply a straight flight of treads without risers, with a pitch sometimes attaining to and even exceeding 45°. The treads are about 20 centimetres in breadth and 20 centimetres in height. The same arrangement is adopted for cellar stairs.

Straight Flight Stairs.—These are generally used as outside stairs. Their dimensions are the usual ones; viz., 90 to 120 centimetres for length of step, and they can be supported by means of brackets, columns, or posts. In the example we give, Figure 17, the string-board consists of two T-irons, 45 inches by 50 inches, united by means of 4 millimetre iron braces or plates, and rests upon a 10-centimetre, cross-shaped iron, into which the lower T-irons vanish, taking the shape of brackets. Figures 18 and 19 show the jointing. A rack made of flat iron, 30 inches by 7 inches, receives the risers and treads made of striated sheet-iron, the other extremity of which is run into the wall. Figure 20 is the staircase on plan.

Stairs between Walls.—In this mode of construction there is no string-board, the treads and risers being built into the wall at each end, and the masonry walls serve alike as supports and as hand-rails for the stairs. Sometimes a hand-rail is let into the wall, consisting of a round iron rod or an iron bar cased in a wooden rail.

Helicoid, Spiral or "Limaçon" (Snail-shaped) Staircases (Figs. 1 to 10).—These stairs are of two kinds: first, those built round a solid newel-post supporting all the steps (Fig. 8), in which each riser is a species of independent gibbet, joined to the rest by the string-board. When such stairs are contained in a cage, the string-board is dispensed with, and the steps are built into the wall. If there be points of contact only with the walls, it is right to avail one's self of them to fix a string-board, so as to relieve the strain on the risers.

Plan of a "Limaçon" or Snail-shaped Staircase.—This form of stair finds its application in warehouses, shops, etc., for purposes of direct communication either with the basement or the first floor. The available space in such cases is limited as a rule, and these staircases at times are reduced to 50 or even 45 centimetres length in the treads. So reduced, the central portion, or rather, the breadth

Fig 11 Elevation

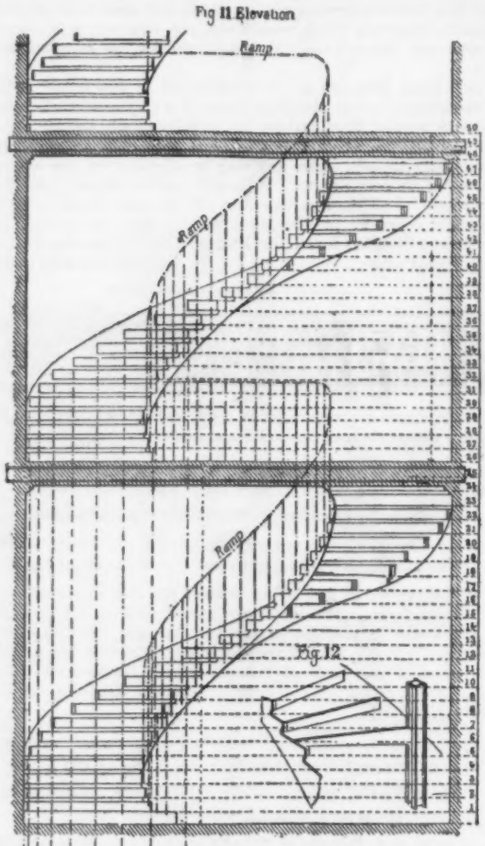
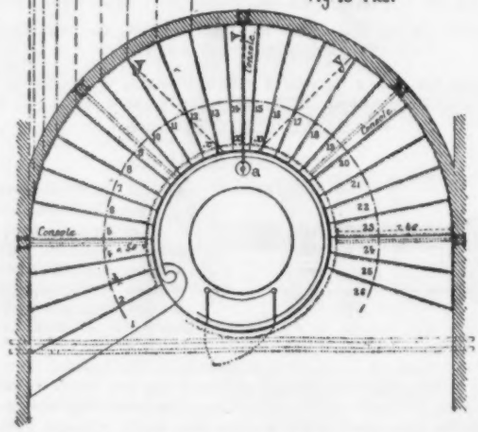


Fig 12

Fig 13 Plan



of the tread in the middle, is very small, something like 15 centimetres to 50 of length of tread, and we are confronted with the problem of the head-room, or sufficiency of space to admit of persons standing erect in ascending and descending. This height, with rare exceptions and to admit of the staircase fulfilling the necessary requirements, should never be less than 1 metre 85 centimetres to 1 metre 90 centimetres. It will be readily understood that in such cases it becomes impossible to increase the breadth of the treads. If, for instance, we desire to have 25 centimetres to give the foot a solid rest, we shall get, in working out a snail-shaped staircase of 50 centimetres length of tread, a radius of 30 centimetres, taking the radius

of a newel of 10 centimetres, say $2\pi R = 1.8849$ metre of circumference at the middle of the step, and if we divided 1.8849 metre by 25 centimetres, we should obtain about seven and a half steps or treads. Let us take eight, and reckoning on a maximum of 19 centimetres of height, we shall get 1 metre and 52 centimetres of elevation between the No. 1 and the No. 8 treads, an insufficient space to stand erect in. To save the loss of time involved in a process of groping, we shall here offer a method of setting out adopted by specialists in the building trade, which always insures sufficient head-room. The dimensions of space and height of ascent being determined, let the circumference be divided into 13 equal parts (Fig. 9), and the height into parts of 17 centimetres as a minimum. Thirteen treads on plan give 14 heights. By deducting that of the fourteenth, there will be secured free passage, $17 \times 13 = 2.21$ m.; and if we take into account the head-room at the landing, we shall have to deduct two treads, or 2.21 m. — 0.34 = 1.87 m. To increase the head-room as much as possible, the landing is shaped into a curve, as shown in Figure 9. In building with iron, the newel-post is made, according to the lengths of the treads, of tubes measuring from 8 to 14 centimetres diameter, the string-board of 3 to 6 millimetres hoop or sheet iron, and the risers of from 2½ to 3 millimetres thickness. The risers are invested at the top and bottom with angle-irons, and likewise at their extremities, and jointed by means of screws to the newel-post and the string-board. We show at Figure 10 an arrangement of great solidity, which allows in staircases of small dimensions of substituting a plain, flat sheet of iron, 50 by 7, in the room of the string-board. This plan consists of making the angle-iron, forming the border for the tread at the outer end, broader in the wing — say about 45 millimetres — and of putting a bolt of 14 millimetres through the newel-post which keeps together the ascending flight. The second type of winding or spiral staircase has a hollow newel. It is more properly called an open circular staircase. This is far more convenient than the staircase with a solid newel, but it involves the necessity of finding more space, though not so much as the square, rectangular, and other types of stairs. It lends itself more readily to purposes of decoration, and may be used for private houses, shops, offices, etc. The hollow or open space should be kept to from 40 to 60 centimetres measurement. The oval and elliptical forms are adaptations of this type; the figure-of-eight shaped one, shown in Figure 3, is very effective. It is just precisely in such special types that iron shows all its many advantages, both as regards the manufacture, the setting out, the bevelling, and the elegance, lightness, and delicacy of form. The construction of the type we present in Figures 1, 2, 3, 4, 5, 6, and 7 is of the simplest. A double string-board, taking the form indicated, is bound together by sheet-iron risers, fitted with angle-irons and Z-irons, as per Figure 4. Open scroll-work at each end lightens the structure as a whole, while a carpet of 70 to 75 centimetres width, laid down in the centre, is secured by stair-rods held by eyes, as seen in Figure 6.

Fig 14 Elevation

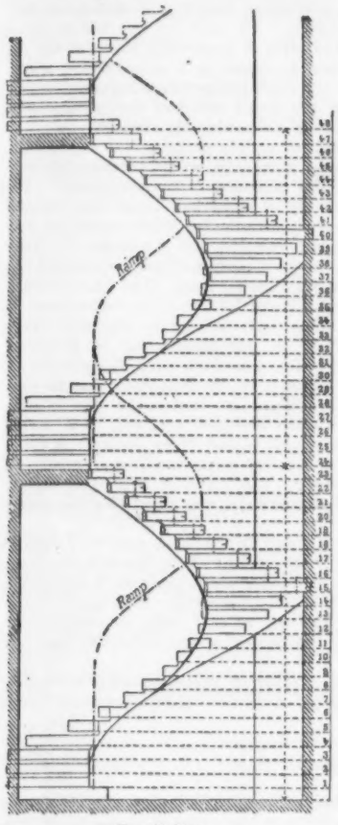


Fig 15 Plan

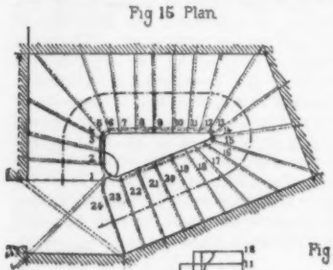


Fig 16

Figure 5 is a section of the riser. One of the rings of the 8 is carried by a small central column, the bearing-strain on which is distributed by four brackets. This small column may be converted into a lamp-post, a bracket-burner with globes, or any other decorative mode of illumination. The upper portion is supported either by carriages (as we shall describe in the sequel when treating of the landings) or by brackets, or by a second column placed in the axis of the ring of 8. This staircase can also be constructed with four columns placed at the points of intersection, formed on the plan by the string-boards. Circular staircases may be adopted also in the case of large houses let out in flats, but in these we must provide for a well-hole of considerable dimensions and large landings. The length of the steps would here vary from 1½ to 1½ metres. The instance we give in Figures 11, 12, and 13 is that of a stair contained in a cage built of iron of 15 centimetres thickness, coating included, as housing becomes impossible in a thin partition. Each flight rests upon five 11-millimetre iron-plate brackets built into the masonry, bolted between the double metallic uprights of the iron casing, and connected with the string-board by means of stout iron squares. To bind the risers there is a false string-board of 5 millimetre iron-plate running round the circumference of the cage. This staircase is adapted to receive a lift. The well-hole measures 1 metre 90 centimetres inside the flight. A lift-cage of 1⅛ metres diameter can very well be made to work in it, keeping it sufficiently away from the edge of the stairs to avoid the guillotine action which would take place if the lift passed too close to the outer string. To effect this we must adapt the flight by raising it, or must fit the well-hole with a metallic netting which gives it very much the appearance of a cage. These means attain the object in view, but the result leaves much to be desired.

Stairs with a Single Central String-board without Well-hole.—This solution is rendered necessary when we are required to build a staircase with the utmost possible length of steps. The string-boards are superposed in the same plane in all the flights, one above the other, while the hand-rails run into each string-board of the next flight. These staircases are made in unbroken flights when the landings are not one above the other, and with intermediate resting-places if the landings are in superposition. These staircases are mainly employed in the construction of barracks, colleges, etc.

Fig 17 Elevation

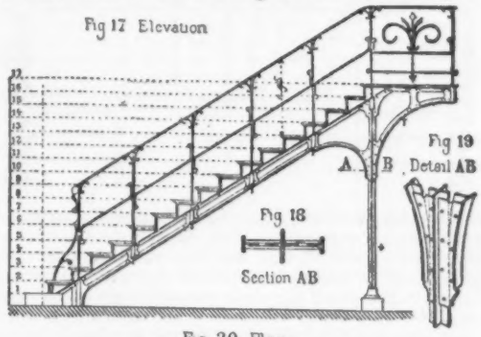
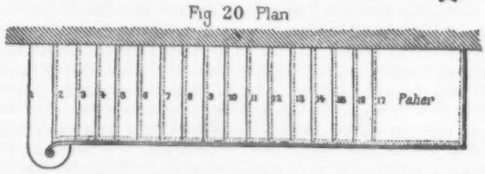


Fig 19 Detail AB

Fig 18 Section AB

Fig 20 Plan



Stairs broken into Landings (Figs. 15 to 22). — These are composed of straight portions according to the walls of the cage, and separated by resting-places (Fig. 22) either at the angles or for intermediate places of access. Figures 14 and 15 represent a servant's staircase, 85 centimetres wide, which presents a combination of the broken and the winding stairs.

Semi-circular Staircases. — These are most frequently found in warehouses and small private dwellings. They are contained in a rectangular cage in a hemicycle. The step varies from 1 metre to 1 metre and 30 centimetres in length, and the well-hole measures 35 to 80 centimetres. As a minimum of dimensions, we may refer to a staircase in a house for letting, built according to the following measurements:

Width of cage	2 metres,	30	centim.
Length of cage	3 "	30	"
Breadth of tread (foothold)	0 "	23	"
Length of tread	1 "	2	"

The height of the steps is 17 centimetres on the ground-floor and 16 centimetres in the upper stories. The ground-floor is 3 metres and 40 centimetres high, and the upper stories 2 metres and 90 centimetres, measured from flooring to flooring. However, we say it again, these dimensions are hardly sufficient, and if adopted, it must be on compulsion to meet the exigencies of plans and of the configuration of the ground. If the well-hole be large enough, say 75 centimetres at the least, the steps may be balanced in a radius; that is to say, their prolongations may be made to converge towards the centre; but to render the transition from the head to the straight, three to six more winders may be introduced, according to the importance of a staircase, the remainder of the steps being parallel to one another. If, owing to the exiguity of the space reserved for the staircase, the well-hole be reduced to 35 centimetres measurement, all the steps must be dancing-steps or winders.

Staircase with Double Revolution.—The staircase with a double revolution, introduced in many buildings, be it square, rectangular, or round, has a central flight of large breadth, and two lateral flights of smaller dimensions, the relative proportion being as 1½ to 2. This type, in more restricted proportions, is employed in many important warehouses, and is well adapted both for a sober style of decoration and for elaborate ornamentation.

Horse-shoe Staircases.—This form is chiefly used for outside stairs. Regarded as an element for monumental structures, its effectiveness is very grand. The staircase in the Palace of Fontainebleau is a magnificent illustration of this type. If made of iron, it is specially suited for porticos with double balustrades. Columns or pillars used for stone staircases are replaced, when the staircase is made of iron, by columns and brackets ornamented to match the taste and style of the building itself for which the staircase is intended.

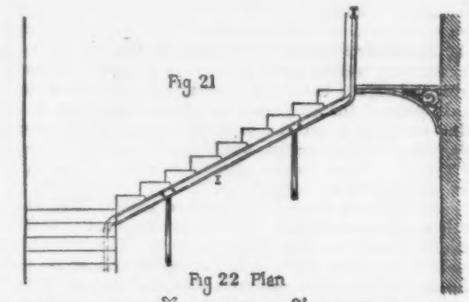


Fig 21

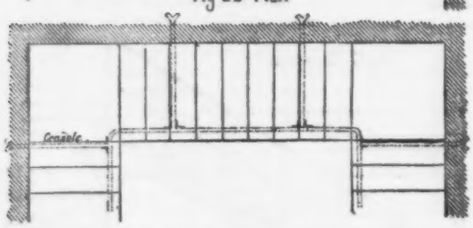


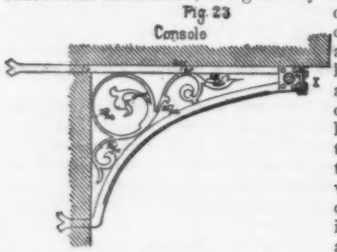
Fig 22 Plan

False String-boards—False string-boards are partial string-boards, fitted to the straight part of bays along the line of a staircase, and in such case they are provided with balusters and hand-rails along the width of said bays or recesses. As stated above, a false string-board may be made to run round the whole circumference of the cage.

Consolidation of a Stone Staircase (Figs. 21, 22, 23).—Consolidated staircases are built of volvic stone—a volcanic lava. The straight steps are simply framed into the wall, 10 centimetres deep. Brackets of 40 millimetre square iron carry a double T-iron of 100, that runs at 10 centimetres distance from the extremities of the steps.

Hand-rails.—The hand-rail of a staircase must never fall short of 90 centimetres in height in the landing, measured vertically from the nosing to the top of the hand-rail. The height commonly adopted varies from 90 centimetres to 1 metre. The distances between the balusters should measure 13 to 14 centimetres in the clear, or, say, 16 centimetres from centre to centre. In ornamental hand-rails made of wrought-iron, the openings, measured at the sides, should not fall short of 15 centimetres, particularly at the bottom. In schools, colleges, educational institutions, and generally in stairs used by children, it is customary to put knobs made of copper or any other metal at 1-metre intervals upon the hand-rails, so as to provide an obstacle to the indulgence of sliding down along the hand-rail. There is a question which, though foreign to the purpose of this article, would seem to merit attention on the part of builders. It is the incidence of lights on a baluster hand-rail. Let us suppose a burner fixed at *a* in Figure 13, the shadows would fall across the steps along the line *x y*. Steps polished with wax are apt to be confounded one with the other as we go downstairs, presenting but very slight differences in tone and shade, especially if the stair is built of fine-quality timber, and the consequence is that we are apt to mistake the shadow cast by the baluster for the limit of the tread, thus running the risk of taking a false step. This defective arrangement has come under our observation on many staircases, and we believe it can be avoided in a variety of ways. Thus, for instance, if the light be suspended beneath each of the landings, the lines of shadow will be very short, intersecting the step more diagonally.

Fig 23



Method of Setting out String-boards (Fig. 16).—After chalking out the plan, settling the balancing of winders and dancing-steps, let the height of ascent be divided according to the number of steps arranged for, and number these divisions 1, 2, 3, 4, etc. Then, with a pair of compasses, or better still, with a steel tape, take the breadths of the treads at the straight of the string-board, similarly to be marked 1, 2, 3, etc. Carry these to the base line, raising them perpendicular to said line. The intersections of the lines bearing the same number will give the angles of each step. Then trace a pattern for a wooden or stone step, and with compasses opened to the extent of 13 to 15 centimetres, trace small arcs on the most advanced portion of the pattern, the tangential points of which, united between them, will form a broken line, which may be rendered more even by converting it into a continuous curve, which will be the under part of the string-board (Fig. 16).

THE EFFECT OF NOT TAMPING DRILL-HOLES.

THE *Engineering News* translates the following remarks of P. F. Chalon, in a late issue of *La Génie Civil*, giving the results of some experiments in abolishing tamping in drill-holes and the gain in rending effect resulting. He says he was led to these experiments by witnessing some tests of a new cap invented by M. Scola, in which the hole was simply closed by a wooden plug about 7 inches long. The plug was not tight, and permitted a considerable escape of gas, and a portion of the useful effect of the powder was expended in projecting the plug to a considerable distance.

The idea then occurred to him of simply plugging the whole with a handful of wet clay, which, in a manner, would hermetically seal it, and the resulting effect of the explosion "was enormous." He repeated the experiments a number of times and found that the dislocating effect of the black powder used under these conditions was much greater than when ordinary tamping was employed. A hole 6½ feet deep was charged with about 2 pounds of gunpowder and the hole closed with a clay plug about 5 inches long. The lines of least resistance in the rock measured 5.9 and 7.2 feet. The mass removed by the explosion equalled 27 cubic yards, or about "13½ cubic yards per pound of powder." (21 cu. m. per kilogramme of powder.) In a second experiment, with a hole 4.26 feet deep, 1.3 pounds of powder and a line of least resistance of 5.6 feet, there was no projection of the rock, but simply dislocation; that is, the best utilization of the explosive. The volume loosened equalled 16.67 cubic yards, or about 12.7 cubic yards per pound of explosive. A third experiment with 2.6 pounds of powder gave an effect of nearly 12 cubic yards per pound of powder. The mean of five experiments, including two charges fired simultaneously, was about 13 cubic yards per pound of powder used.

Under ordinary conditions of firing in the same quarry, 7.5 cubic yards per pound of powder was the result. Thus the new tamping, even at the low average figure of 9 cubic yards per pound of powder, amounts to a decided increase in effective result. The same results would probably follow from the use of any other substance than clay for hermetically sealing the mouth of the drill-hole, says M. Chalon.

The author says further, in explaining these remarkable results, that the explosion under mining conditions always produces three distinct effects:

1. The breaking of the base of the hole.
2. The dislocation of the sides.
3. Projection.

Each of these effects is more or less marked, according to conditions, and one may exceed in effect at the expense of the other two. The work of breaking is difficult to calculate, but Mr. Chalon thinks it is not less than 15 per cent of the total work. The work of projection of powder, in fire-arms, is about 14 per cent, and we can suppose that it is about the same for powder used in mining. The effect of projection is manifested in a special manner sometimes in mining, as when the explosion results in "a gun," to use a mining expression; that is, when the work is expended in blowing out the powder or in slightly enlarging the diameter of the bore-hole without breaking the rock. Generally the effect of projection is to displace the broken rock and throw it to a greater or less distance from the site of the explosion. This is practically work entirely lost, and equals about 30 per cent of the total work when the breakage is included.

On the other hand, when the charge is compressed under hard tamping and reduced in its normal volume, the powder has not time to burn completely, and a good part of it is dispersed without useful effect upon the rock. With mining-powder, in grains, the author estimates that 20 per cent in weight of the powder is thus wasted. Thus in each kilogramme, or 1,000 grammes of powder only 800 grammes do any effective work; and as the power lost in breaking and projecting equals 30 per cent of the total work, there remains as utilized only 800 x 70 = 56 per cent. That is, the useful effect of a kilogramme of powder, under tamping, represents not more than 56 per cent of the total theoretical work.

In now considering the case where the tamping is omitted, we have an air-chamber superimposed above the charge, permitting the powder to become thoroughly ignited and the gas developed to expand regularly and manifest its power throughout the whole extent of the sides. And the force of projection is also diminished, as can be proven by the relatively short distance to which a wooden plug embedded in the clay would be thrown. The loss from unburned powder is less, as shown by the light smoke and the disappearance of this immediately after the explosion. Taken the figures first given, it will be seen that without tamping the useful effect of the explosive is about 76 per cent in place of 56 per cent of the total theoretical work.

M. Chalon sums up the advantages of the omission of hard tamping as follows:

1. Economy in hand-labor.
2. Economy in material, as the powder is utilized better.
3. Better rending effect.
4. The suppression of the accidents so often resulting from tamping.

In his experiments the charge was placed at the bottom of the hole under the usual conditions, connected with a fuze or electric conductors, and the mouth of the drill-hole was then sealed by a clay plug 5 or 6 inches long. It is essential that this plug is fitted tightly, leaving no fissures for the escape of gas before combustion is complete. In place of clay, cement or plaster-of-Paris might be used.

SIMPLE METHOD OF TRACING THE JOINTS IN ELLIPTIC ARCHES.

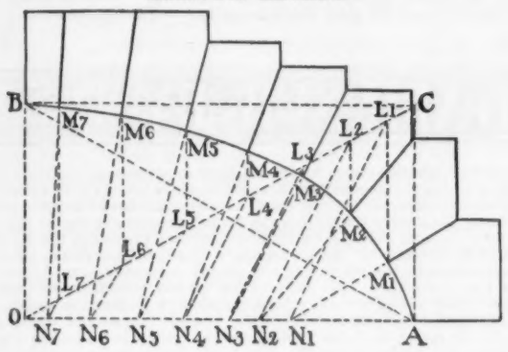


Fig. 1.

M. MAURICE D'OCAGNE, in *Les Annales des Ponts et Chaussées*, gives the following simple method of tracing the joints in elliptic arches:—

Let $m^1, m^2, m^3 \ldots m^7$ (Fig. 1) be points in the quarter ellipse $A\ B$, on which it is required to trace the joints normal with the ellipse. The tangents to the points A and B intersect at C; we then draw the lines $A\ B$ and $O\ C$. The perpendiculars to $O\ A$ dropped from $m^1, m^2 \ldots m^7$, cut the line $O\ C$, at the points $L^1, L^2, L^3 \ldots L^7$. The perpendiculars to $A\ B$, carried from the points L^1, L^2, etc., cut the line $O\ A$ at the points $N^1, N^2, N^3 \ldots N^7$. Then the lines $M^1\ N^1$, $M^2\ N^2$, etc., are the normals sought for.

The proof of this method is very simple. Let $M\ N$ (Fig. 2) be the normal to an ellipse at the point M. From the point N, we draw towards $A\ B$, the perpendicular $N\ L$, cutting the ordinate $M\ P$, at L. We now have, by a well-known property of the ellipse, the equation,

$$\frac{P\ N}{O\ P} = \frac{b^2}{a^2}$$

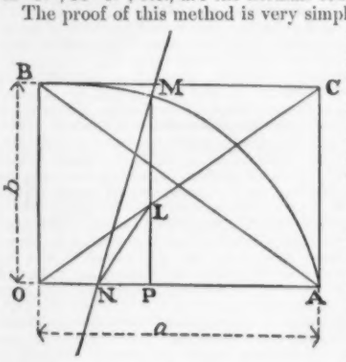


Fig. 2.

The triangles $P\ L\ N$ and $O\ A\ B$, having their sides perpendicular to each other, we have the equation,

$$\frac{P\ L}{P\ N} = \frac{a}{b}$$

Multiplying these together we have

$$\frac{P\ L}{O\ P} = \frac{b}{a}$$

which demonstrates the fact that the point L must be located on the line $O\ C$.

COMMUNICATIONS

THE POINT OF GREATEST DEFLECTION.

LOUISVILLE, KY., September 30, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs,— In your issue of October 23, 1886 (No. 565), I find a letter of Mr. Fred. T. Slade, referring to the position of the point of greatest deflection; permit me to say that neither the statement in that letter nor the formula given for the deflection in the article on "Safe Building" (No. 562, October 2, 1886), are complete. We have:

1. If $m \angle n$:

Distance of point of greatest deflection from right-hand support

$$= \sqrt{\frac{n\ (l+m)}{3}} = \sqrt{\frac{l^2 - m^2}{3}}$$

Greatest deflection,

$$\delta = \frac{w.\ m.\ n.\ (l+m)}{9.\ l.\ e.\ i} \sqrt{\frac{n\ (l+m)}{3}}$$

2. If $m \nearrow n$:

Distance of point of greatest deflection from left-hand support

$$\sqrt{\frac{m\ (l+n)}{3}} = \sqrt{\frac{l^2 - n^2}{3}}$$

Greatest deflection,

$$\delta = \frac{w.\ m.\ n.\ (l+n)}{9.\ l.\ e.\ i} \sqrt{\frac{m\ (l+n)}{3}}$$

I wish to add another remark. The article on "Safe Building," in No. 536 (April 3, 1886), gives "modulus of rupture — *Brechungs coefficient.*" This is a slight mistake, modulus of rupture is in German, "*Bruch coefficient;*" *Brechungs coefficient* means "index of refraction." Yours truly, CARL BOECKLEN.

THE RECOVERY OF PLANS FROM A CONTRACTOR.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — Please wire immediately cases of suits by architects for recovery or value of plans retained by contractors or others.

"HASTE."

[WE do not know of any successful suits by architects to recover plans The precedents are all the other way. The most noted case is that of Tolman *vs.* Phelps, "*District of Columbia Reports.*" Here Tolman, an architect, sued for recovery of plans from Phelps, who, as he thought, was misusing them, and took the law into his own hands by secreting the drawings. The result was that he was sent to jail for larceny, on a criminal complaint preferred by Phelps, and lost his own suit, the court awarding the ownership of the plans to Phelps. There have been several English cases between architect and owner, in all of which it has been held that the owner was entitled to keep plans made by his architec . Of course, he is bound to pay for the architect's services, but that is another matter. As between architects and contractors we do not know of any decisions. Perhaps the architect would do best to claim them through the owner, who, if he can demand them from the architect, is all the more entitled to compel the builder to give them up. — EDS. AMERICAN ARCHITECT.]

THE PROPER FEE FOR AN ARCHITECT COMPELLED TO ACT AS CONTRACTOR.

WYANDOTTE, KAS., 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — I am building a large private residence, and have made arrangements with the owner at five per cent commission for full services as architect.

Now, in the course of two months he is dissatisfied with the contractor and urges the architect to finish building the house by the day, the architect to hire the men, buy the material as cheap as possible, and, in fact, tend to everything so as to build it according to the plan and specifications; now I should like to know what commission the architect ought to have for full services and building the house?

[WE do not know that any rate of compensation has ever been settled for this sort of extra work on the part of the architect. As most of us know, it is not unusual for architects to be called upon to manage the completion of a building in just this way, and we imagine that it is the general practice to add to the regular commission a round sum which will fairly pay for the extra time necessarily spent in doing the work of a contractor. Some of us, perhaps, have grumbled a little to ourselves at the disparity between the fifteen or twenty per cent profit which the builder would expect as compensation for his services, and the modest charge which seemed to us all we should probably be able to collect for doing the same work, and we should be glad to know whether any of our readers have ever heard of a way of regulating the fee for additional service of the kind, which should be fair to both parties, and easily understood. — EDS. AMERICAN ARCHITECT.]

SOME INSTANCES OF DRY-ROT.

NEW YORK, N. Y., November 1, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — As the question of the best way to resist dry-rot in timber has again come up, by the discovery of the decayed condition of the floor joists in Holbrook-Hall in this city, it may be well to note an instance or two of a similar nature, as a warning which may be valuable in future constructions. In the case of the floors in the hall above referred to, they were constructed of 3 x 8 inch beams laid not only close together, but the joints between them were hermetically sealed by paper below and by a coating of hot resin or pitch on the upper side, closing the joints. This was no doubt the cause of the decay of the timber; as, if the beams were laid roughly together, with the joints open at top, there could have been an access of air, which would have sufficed for their preservation.

This deprivation of air has been proved in a great many cases to be the cause of the rotting of timber. Many years ago, the late R. M. Hoe, of the well-known firm of R. Hoe & Co., of this city, undertook to make the wooden posts and girders of a warehouse fireproof by coating them with plaster and cement; not long after, he discovered that they were rotting, and had it all stripped off. The case of the roof-trusses of the late Dr. Bellows's church in this city is another which fully illustrates this point. Evidence of settlement

at one end of one of the trusses caused an examination, which revealed the fact that the foot of the rafter and the end of the tie-beam were encased in a very large cast-iron shoe fitting tightly therein. Upon removing the timbers they were found to be half rotted off.

I was informed by the late John J. Serrell, the well-known surveyor of this city, that a floor laid by him in his house at Bayonne, N. J., was rotted by this cause. The floor was laid upon a concrete layer, or deafening, and covered with an oil-cloth in a hall-way. In walking over it he found that it gave way under his feet; taking his pocket-knife he found that he could run it through the boards anywhere with ease — except at the edge of the cloth, where the boards had not rotted, as there they had access to the air.

But if timber is immersed in water, only the surface decays for a short distance in, and the rest is preserved for hundreds of years. I have myself taken out timbers of an old dock, built in 1810, from filled-in ground and found it perfectly sound.

Yours truly, O. P. Hatfield.

Notes and Clippings

Cloak Rooms in Churches. — Apropos of the structural defects of churches, which, I am glad to see, are attracting some attention just now, it is an astonishing thing that it has never occurred to any one to provide cloak-room accommodation at places of worship. I always feel a difficulty myself about going to church on wet Sundays, because I do not know how, when I get there, I shall dispose of my umbrella and macintosh with comfort to myself and without annoying others. No doubt many sensitive persons feel the same. Then, again, look at the hat difficulty. Few men can afford a new hat a week, yet no man can respect himself in a hat that has once been under the seat during a whole service. And how, I ask, can an average Christian perform his devotions in an acceptable spirit, with the knowledge that, as he kneels, he is putting his foot through the crown of his Lincoln and Bennett? I see that at the Church Congress the subject of "Hindrances to Devotion" is down for discussion, but I shall be much surprised if any reverend orator gives a thought to this aspect of the question. Yet I am convinced that a cloak-room, with a civil attendant to take charge of hats, umbrellas, etc., would do much to promote true piety, and would be a greater attraction than a sensational preacher — or even "church privileges." — *London Truth.*

A Light twelve Times as cheap as Gas. — A very successful demonstration of its (lucigen's) great lighting powers was recently given at the Crystal Palace. The method of producing this light consists in forming an intimate mixture of air and minutely-divided oil particles, resulting, when ignited, in a continuous, steady flame of great brightness. The mechanism, which is very simple, is worked by a small supply of compressed air, and the flame is under perfect control by merely turning a tap. As the light is produced by the combustion of crude and waste oils, its cost is, by actual measurement by the official gas analyst for Glasgow, found to be from one-tenth to one-twelfth the cost of gas, and about one-twentieth that of electric light of the same actual candle-power. It is stated that an area of half a square mile can be flooded with light equal to daylight at an expenditure of one shilling and three pence per hour. The great value of this light lies in its diffusiveness, which adapts it so admirably for use on works or where any outdoor operations have to be carried on at night. A naked arc-lamp in a room is so blinding that work cannot be done; but when an opalescent globe is placed over it, so as to reduce the intensity, the eye sees details in the room much better, although the opalescent globe has cut of three-quarters of the light. The effect of the lucigen may be imagined, as it is said to produce a flame of 3,000 actual candle-power, or equal to six large arc-lamps, while its radiative-surface is about 350 square inches, as against one square inch for the arc-lamp. The result is that the lucigen gives a light of a quality highly effective for working purposes. The lucigen marks the latest advance in the history of the production of light from carbonaceous substances, as not only does it raise the carbon particles to the most intense white heat, but the form of the flame is such as to retain them in that condition for the longest period. The lucigen has been adopted at a large number of works in this country, including those of the Fourth Bridge, and it is also in use by the French Government for military operations. — *Iron.*

The Ancient Sepulchral Reliefs at Athens. — The unique series of ancient sepulchral reliefs which have been brought to light by excavations in the Cerameicus, the public cemetery of ancient Athens, have two interests, at any rate, which it would be hard to exaggerate. For one thing, many of them are extraordinarily beautiful; for another, they illustrate, as nothing else does, certain aspects of Athenian life and civilization at a period when Athens was still one of the great powers of Greece. Naturally, these reliefs are exceedingly various, both in date and workmanship and character. Some of them are archaic and stiff and formal. Others, again, easily distinguishable, are simply bits of bad work. But a large number are full of the most exquisite beauty and pathos, and it is chiefly of these that we wish to speak. In a great number of cases the artist has chosen for representation on these monuments the last farewells between the dying person and the survivors. Evidently, this was a very favorite form of sepulchral monument, and it admits of the expression of a far more delicate and a deeper pathos than any other form. There are reliefs representing the last farewells between husband and wife, between father and son, between mother and daughter, between friends. Sometimes the representation is allegorical. A lady takes her last look at her casket of jewels, which stand allegorically for the pleasant world to which she is saying farewell, and the relief is saved from all charge of triviality by the exquisite sadness of the lady's face. Of course, it must not be supposed that all the best reliefs represent these farewells. One of the most famous, erected to Dexileos, represents him as a victorious warrior in battle, slaying his foe. Still, what we have said is a true general description. Now, in order properly to appreciate the spirit of these grave monuments, we must remember that to the Greek death was necessarily far more terrible than it is to us. In the nature of things, he could have no "sure hope of a glorious resurrection." Whatever may have been the exact conception of death current among the average Athenians of, say the fourth century, B. C., we know that they considered it "the supreme evil." Very few people indeed could have been convinced by Socrates's famous argument to his friends after his trial that it must, after all, be reckoned to be a good thing. To the ancient Greeks it was not only a dreadful mystery, it was a final parting from all that they held dear, from their families, from their friends, from life itself. It still had all its bitterness. Nothing could have been keener than the grief which it excited. — *The Spectator.*

Trade Surveys

A slight reaction seems to be setting in in manufacturing trade circles in the direction of higher prices. A month ago this was not even anticipated. The improvement may only be upon the surface. It is difficult to probe a matter of this kind to the bottom and furnish reasons one way or the other. The only apparent cause for the slight weakness in prices and the temporary dulness in demand for the past week or three weeks seems to have been brought about by the scare over the alleged stringency in the money market a few weeks ago. That scare having passed, confidence returned and orders began to drop in upon manufacturers and jobbers for merchandise and material of all kinds. The mills, factories, shops and mines of the country do not seem to be producing more goods and supplies than are wanted. For eighteen months past there has been no accumulation of goods, and no depression in prices in consequence of any accumulation. Nearly every manufacturing interest has been oversold for twelve months. The building interests have been crowded. The manufacturers of building material have had a profitable demand for their entire output, and even at this time, when the year's operations are drawing to a close, builders and manufacturers speak with a good deal of confidence of the prospects for the coming year. In New York City, Philadelphia, Chicago, St. Louis, Minneapolis, Omaha, and Kansas City reports have been received which confirm opinions recently expressed concerning favorable prospects of next year's building operations. Of course, opinions of this kind are tentative only and are based upon the fact that this year has been a good year, and that everything next year will be also as good. All the mill and shop capacity built this year has been engaged, and will be occupied as soon as ready for machinery, and the machinery will be run as soon as it is ready for steam. All of the houses built are now rented and a liberal percentage of them have been sold. The house-building authorities in New York and Philadelphia have recently given it as their opinion that the limit of building has not yet been reached, especially in the direction of moderate-sized houses. In Philadelphia builders have made purchases of land for the construction of as many houses next year as this. In such smaller cities as Pittsburgh, Cleveland, Toledo, Indianapolis and Springfield, O., a great industrial building activity has been maintained all the season, and as much building will be done during the winter months as the weather will allow. It is to be observed that vigorous building enterprises exists at manufacturing centres both North and South. Material of all kinds continues cheap, except brick. Slate, stone, lath, shingles, plaster, cement, glass, and the various fixtures which go into the interior of a house are all cheap, and no advance is probable because of more or less extensive preparations which those interests are now making to supply the improving demand. Railroad earnings for nine months on reporting railroads are of a character to stimulate construction. Clearing-house returns for the last weeks show a declining activity in trade. Iron and steel makers are turning out daily 21,000 tons of pig-iron and 7,000 tons of rolled-iron. Importations have reached, so far this year, over 1,100,000 tons of iron and steel material. Some authorities predict a depression in consequence. Iron-making is rapidly expanding. Forty wood-working machinery establishments have been put up during the past season. Boiler and engine makers are oversold to January 1. Ship-building contracts now in will keep yards busy most of next year, and boat-yards that will employ about 2,000 men will be in operation next spring. The anthracite-coal strike still continues, but as compared to last year the weekly deficit is not 30,000 tons. Last week's production was 740,000 tons as against 766,000 tons for same week last year. The total output reported is 27,700,000 tons, or 2,400,000 tons over last year. The lumber trade continues active and hardwood of all kinds is especially active and firm in price. White pine is moving freely. At Lake Superior points there are heavy stocks on stick, owing to high freights. Lumber has recently been advanced in several Western markets, but in the East there are sufficient stocks to keep prices uniform. Chicago dealers propose to tone up prices. Yellow pine receipts are heavy at North Atlantic ports. Sap is scarce at one or two points and is marked up fifty cents. Planing-mill supplies are low. The money market is well supplied and the business interests feel free from apprehension of stringency. The volume of money throughout the West and South is ample for all requirements, and frequently discounts are asked for prompt payments. The distribution of all kinds of merchandise is beyond precedent, and jobbers and retailers are in a joyful frame of mind over the favorable trade developments. Textile mills, shoe interests, clothing manufacturers, all speak of excellent spring prospects. Within a week car-builders have booked contracts for 5,000 cars, and there are orders for as many more held back. Nail-makers are still crowded to the wall. Plate-iron makers have, in some cases, spring orders booked. The coming year will be an active one for machinists and machinery-makers. Steam-power is urgently wanted, and the coming winter's work will be devoted to filling orders for spring erection. So far this year twenty-five hundred industrial enterprises have taken shape in the fourteen Southern States. This activity will not abate, as a great deal of railroad construction is projected for next year in the South and Southwest. Land speculation is not absorbing quite as much capital and it is safe to say that the well-understood dangers to be dreaded from ill-advised investment in that direction will prevent a ballooning of land values.

The American Architect and Building News

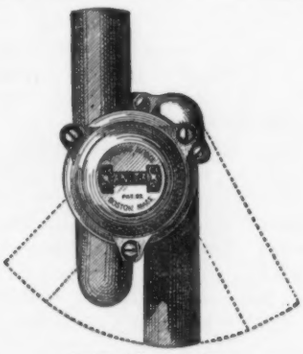
ADVERTISERS' TRADE SUPPLEMENT.

No. 65. SATURDAY, NOVEMBER 5, 1887. VOLUME XXII. No. 619.

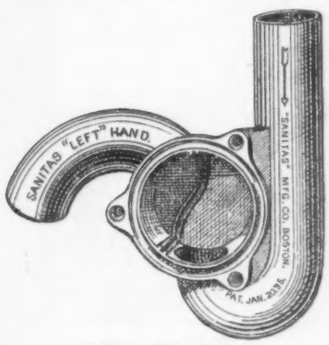
"SANITAS" PLUMBING APPLIANCES.

THE Sanitas Manufacturing Company, 207 Tremont Street, Boston, Mass., takes pleasure in announcing that they have opened a branch office at No. 92 Beekman Street, New York, N. Y., where their patent plumbing appliances can be seen under operation. They have also made arrangements to open a Chicago branch, which will be ready for work early in the month.

Sanitas Right-Hand Trap.



Sanitas Adjustable Trap.



Sanitas Left-Hand Trap.

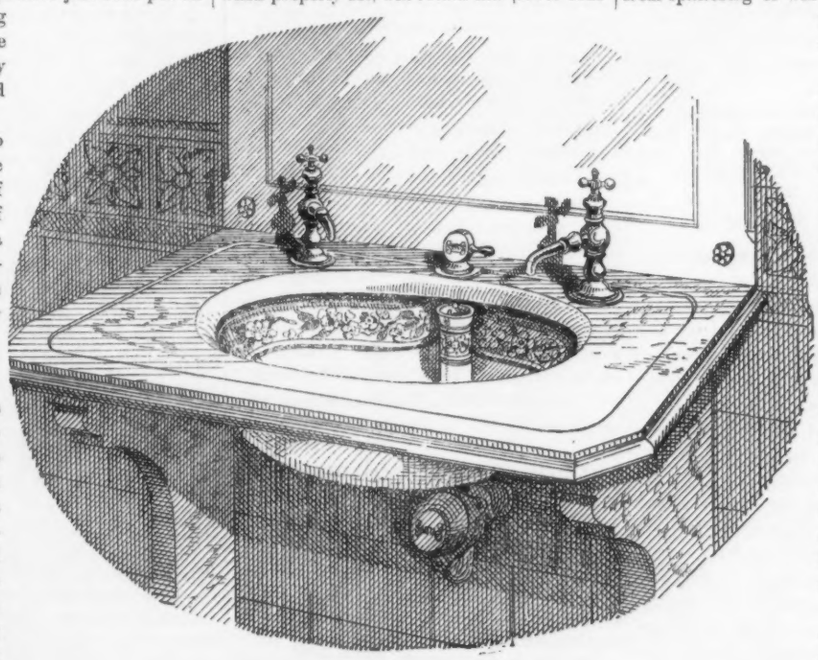
The Sanitas appliances consist of the Sanitas Trap, the Sanitas Water-Closet and the Sanitas Lavatories. Several new forms of the Sanitas trap under the name of the Sanitas "Adjustable" traps have just been put on the market, enabling the plumber to set the trap with great facility under any fixture and in any position.

The traps are also now made of white metal and brass, or of all brass, as well as of lead, and present a very ornamental appearance when set open as, particularly, under wash-basins.

SANITAS TRAP.

The Sanitas Trap is the only self-scouring, simple water-seal trap ever invented, which retains its seal against siphonage, back-pressure, evaporation and all other adverse forces which can occur in good, modern plumbing work. It is free from all obstructions to the water-way, such as gates, valves, or balls, and has no working parts to get out of order. It requires no back-venting to preserve its seal. The trap may, however, be vented like other traps if desired, and it has the advantage when so vented, over ordinary vented traps, of not losing its seal by evaporation, for the vent may be applied below the outlet a sufficient distance to bring the water-seal out of the reach of the induced air-current which causes the evaporation. The ordinary S-trap cannot be so vented without subjecting it to the danger of self-siphonage, from which the Sanitas trap is free. The Sanitas trap has a greater power of resistance to siphonage unvented than the vented S-trap, and, when properly set, will retain this power indefinitely, even under sinks, which the vented S-trap will not. Therefore the expense, danger and complication of venting may be avoided, and greater safety and simplicity attained.

The Sanitas trap may be opened with an ordinary screw-driver, which every house owner has at hand and knows how to use. This gives easy access to the trap and waste-pipe.



The Sanitas Lavatory.

THE "SANITAS" WATER-CLOSET.

The Sanitas Closet has the simplicity of the Short Hopper, all the sanitary advantages and conveniences of the best improved modern closets, and others peculiar to itself, in being antisiphonic, quick-acting, self-sealing, free from spattering or waste of water, and, when properly set, almost noiseless in operation.

The supply-pipe between the cistern and the closet stands permanently full of water, and, discharging below the level of the standing water in the bowl, the action is instantaneous and the noise of flushing is deadened, so that with the cover down and toilet-room door closed no sound can be heard from without. The water is held in the supply-pipe by atmospheric pressure, and will instantly restore the trap-seal should it at any time be lowered by evaporation or siphonage.

The Sanitas water-closet can be flushed with less than two gallons of water. The valve closes automatically, and is regulated when set by a simple thumb screw.

THE SANITAS LAVATORIES.—SANITAS BASIN, BATH-TUB AND PANTRY-SINK.

Quick emptying, with stand-pipe overflow. These fixtures discharge very rapidly, scouring the trap and waste-pipes. The overflow-pipe stands in a recess in the back of the fixture, and does away with the ordinary foul secret overflow-passage, and the troublesome and dirty plug and chain. A single motion of the hand opens and shuts the outlet. By this device the utmost simplicity, convenience and cleanliness are obtained. The stand-pipe may be readily detached from the lifting device to facilitate burnishing or scrubbing. The Sanitas basin stand-pipe is made either of brass or earthenware. When made of earthenware, like the basin itself, all visible submerged metal work and consequent burnishing is avoided, and the stand-pipe admits of colored decoration, like the basin itself, producing with the latter an ornamental effect altogether original and unsurpassed.

Ordinary lavatories have outlets so contracted that they discharge a stream in size scarcely a tenth of the capacity of their waste-pipes. The result is a gradual accumulation of filth therein, and a highly unsanitary con-

The Water-Closet.

dition of affairs. No trap, or even straight pipe, whether vented or unvented, can be kept clean under such lavatories. The Sanitas lavatories, on the contrary, fill the pipes "full-bore," and strongly scour them.

Our cut represents a decorated Sanitas basin, with decorated porcelain stand-pipe. The Sanitas adjustable trap is coupled directly to the outlet of the basin.

THE SANITAS MANUFACTURING CO.,
207 Tremont Street, Boston, Mass.
Branch Offices, 92 Beekman Street, New York, N.Y.; 47 and 49 Dearborn Street, Chicago, Ill.

OPEN FIREPLACES.

The open fireplace is at once the most primitive, and the most popular means of heating which we possess. Originally it was little better than an open hearth in the centre or at the sides of the room, unprovided with a chimney; the only outlet for the escape of the smoke being a hole in the roof. From this simple prototype it has, after a long series of improvements, been developed into the scientific and ornate forms of our own time.

Modern household taste has firmly accepted the open fireplace as an indispensable adjunct of the home, and our architects have turned this taste in the right direction by designing fireplaces which shall sustain the artistic effect of the entire house. Under these conditions, the fireplace has rapidly become the centre of social and decorative interest, being the one spot in the room towards which all eyes are naturally drawn, and around which the amenities of home find their best expression.

The exterior of the house also began to take on new forms, for the chimneys being increased in number offered the architect an unlimited field for their picturesque grouping and arrangement, and thus the coming of the fireplace indirectly affected the architectural possibilities of the exterior of the house as well as the interior.

The rich, warm tones of the artistic tiles now used to decorate the fireplace have given it an added charm, but at the same time called for a new arrangement for its inside surfaces. The soapstone and brick linings heretofore used were at once found to be too plain and cold to harmonize with the decorative effect of the tiles, and a new artistic element was called for. This was supplied by making the back and sides of the fireplace of cast-iron plates, bearing rich relief designs which harmonize admirably with the warm color of the tiles. Their introduction at once marked a new era in the treatment of the fireplace, and indicated in an unmistakable manner the direction in which this branch of decorative art was tending.

Under the impulse thus given to the movement, we perfected a system of manufacture of these specialties, and undertook a series of designs which should embody all the foregoing requisites.

In order to ensure the highest results, which should baffle all attempts at unworthy imitation, the services of some of the best artists were secured, and patterns modelled in clay were made at great expense.

These designs we cast in iron, and on their appearance they at once superseded all former patterns, and were accepted as the highest developments of art yet applied to fireplace decoration. These early specimens found their way into many of the best houses in the country, and the demand being thus established, additions have been made to our assortment, until we have a collection that is altogether unique in design, and that is pronounced by connoisseurs to be the finest as well as the largest in the world. Our assortment comprises the combined collections of Lockwood, De Forrest and C. A. Wellington & Co., as well as specially modelled designs by Elihu Vedder and our own artists.

In perfecting these designs we have had in view their adaptation to the different styles of interior decoration used in modern houses, and our varied assortment enables us to match any style of interior finish that the architect or decorator may call for.

The classic type is well rendered in the finely modelled "Vulcan" and in the basso-relievo of the old "Roman" brick patterns; while in the "Lion" and "Florentine" patterns two types of the Renaissance are presented. The "Romanesque" and "Medallion" patterns are also typical examples of another period, and the beautiful "Moorish" back is closely allied to some exceedingly rare specimens of mural decoration from the Alhambra.

The "Mediæval" and "Abbotsford" patterns are characteristic of the Middle Ages, when themetals that protected person and property were so curiously wrought and fashioned. The old Dutch and Elizabethan patterns are identical with the highly prized Backs that are sometimes found in old colonial houses.

For purely figure-work nothing has ever been produced equal to the "Crusader" design. It represents a Mediæval battle with all its attendant scenes of life and action.

For illustrative work the "Macbeth" pattern is much admired. The "Crusader" and "Macbeth" are our two latest productions.

In addition to the above styles we take a pardonable pride in referring to the celebrated De Forrest collection.

The original patterns for these Backs were designed and executed by native artists in the employ of Mr. De Forrest at his establishment in Ahmedabad, India, and are the only specimens extant of true Indian art applied to fireplace linings. The extreme grace and delicacy of these styles will at once commend them to our patrons.

In addition to the above series we call attention to two superb designs by Elihu Vedder, in which the peculiar style of that artist's work is seen at its best. They were modelled with that painstaking care that is always characteristic of the real artist, and the possession of one of these specimens of Vedder's genius, marks an era in the furnishing of the house, and tends to make the fireplace the one spot where the decorative interest of the room culminates.

We have the exclusive control of Mr. Vedder's productions in this department.

These linings being copyrighted, our patrons are thus assured that their present high standard will be maintained, and their value will never be impaired by the appearance of cheaper productions. These linings are manufactured exclusively by us, and partake of that excellence of material and workmanship so characteristic of our sanitary heating and cooking specialties.

All of our fireplace linings, grates, etc., can be furnished in plain iron, antique brass or copper finish, when desired.

We solicit the correspondence of architects and interior decorators, as well as of consumers, generally throughout the country.

SMITH & ANTHONY STOVE CO.,
52-54 Union Street, Boston.

TERRA-COTTA.

With confidence, we make the following claims:

1. There is no more durable building material known than such terra-cotta as we are now producing.

2. It will sustain a crushing weight of 6,000 to 8,000 pounds per square inch.

3. It admits of greater ornamentation for the money than any other material.

4. It is so much lighter than stone that it costs much less to put it in place.

5. It withstands the action of fire and water much better than stone and iron.

6. In the coming era of fire-proof construction it is destined to take front rank.

7. We were awarded the gold medal of the Massachusetts Charitable Mechanic Association in 1881.

8. Improved methods and management have greatly reduced the cost of and removed many former objections to the use of terra-cotta as a building material.

9. We are sending out work to New York City, Brooklyn, Buffalo, Philadelphia, Harrisburg, Washington, St. Louis, Nashua, Savannah, New Orleans, and numerous other cities of the Union, and to Canada.

10. Boston is far behind New York and the West in the use of this material, and we earnestly solicit for it your careful attention.

Please visit our factory at 394 Federal Street, where we shall be pleased to show you our work in process and can present to you facts of great interest.

BOSTON TERRA-COTTA COMPANY,
394 Federal Street, Boston.

HOW SHALL WE WARM AND VENTILATE OUR SCHOOLS?

THE proper heating and ventilating of our buildings constitute the most important elements of comfort and domestic economy. More discomfort and unpleasantness is caused in our schools and households by the ignorance of builders and house-owners of the first principles of sanitary heating than from any other cause.

Sanitary heating is the art of reproducing in the house a warmed atmosphere of the freshness and vitality of outdoor air. To do this the cold air furnished to the furnace or radiator must be taken from the outside and passed through the furnace or radiator in abundant quantities without overheating, and rendering it absolutely free from gas, dust and all other impurities. Provision must also be made for removing the air from the room after it has been vitiated by breathing and other causes. When these principles are applied successfully, perfect sanitary heating is obtained.

The Steam and Warm Air Combination Heater (illustrated by the engraving in connection with this article) is manufactured by the J. F. Pease Furnace Company of Syracuse, N. Y., and Toronto, Canada, and is admirably constructed in regard to all that is required for the purposes of perfect heating and ventilation. It has points of merit which are peculiar to itself alone, and which are possessed by no other apparatus.

Mr. J. F. Pease, the inventor of all the apparatus manufactured by this Company (the patents for which they own solely for the United States and Canada), some years ago conceived the advantages to be gained by combining steam and warm air in such a manner as to produce pure warm air without overheating it.

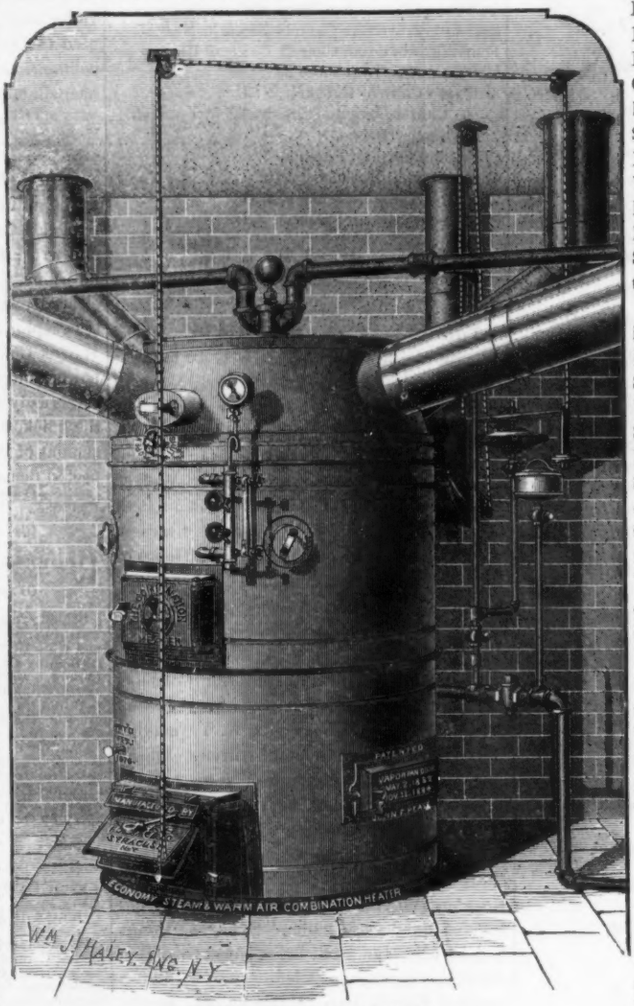
This heater, which is the outcome of this idea, and on which important improvements have been made, is constructed with a plate-steel, tubular, upright boiler suspended directly over the fire-pot. This boiler is encased by a dome and radiator, which in turn, is surrounded by a casing of galvanized-iron (double-lined to prevent radiation of heat in the cellar), with an ample space between, forming the warm-air chamber.

The radiating-surface is unusually large, and there is no danger of overheating or burning the oxygen, while the steam may be carried to the same rooms as the warm air, and the heat radiated either by direct or indirect radiators, as may be preferred. In this construction the fuel which produces the warm air generates the steam, and two results are obtained from the same fire, and the steam may be conducted to such rooms as are not accessible by warm-air pipes. The cold air is taken from the outside into the warm-air chamber of the heater and distributed through the warm-air pipes and registers to the various rooms to be warmed, producing pure, warm air. The heater may be set double-cased, portable, or in brick, as may be desired, although the double-cased portable is considered the more satisfactory, and radiates little or no heat in the cellar.

By combining the steam heat with the warm air a pleasant and healthful summer atmosphere is produced throughout the building, and the air in all the living rooms is constantly being changed, which contrasts strongly with the stifling heat in buildings warmed by direct steam radiators alone, where there can be no circulation nor change of air, and consequently the heat is suffocating and unhealthful.

A valuable advantage gained over all steam-heating is the ease with which the heater is controlled for all temperatures required. In the chilly days of fall and spring, the fire may be run as low as desired, producing just enough warm air to take the chill from the house without making steam at all until wanted, which result, of course, cannot be obtained with an all-steam heating apparatus, with which it takes as much fire to make steam on a chilly day in October as on a cold day in January, and great discomfort by overheating is often the result. The boiler, which is constructed in one piece (not sectional), is tested to one hundred pounds, both steam and hydraulic pressure, while from one-half to five pounds is all that is required for heating, and provision is made for the steam to escape through the safety-valve at ten-pound pressure. After the boiler is once filled, it only requires about a pail of water per week, as the condensation from the radiators and pipes is returned to the boiler by gravity pressure.

The drafts are automatically controlled by the heater. The apparatus is durable, noiseless, powerful and compact, requiring but little space to set it, and will produce at least 25 per cent more steam and warm-air heat from a given amount of coal than heaters of ordinary constructions. The boiler and entire apparatus can be cleaned inside of twenty minutes, and without dumping the fire.



The Economy Combination Heater.

The important features embodied in this apparatus make it most desirable for heating buildings which demand perfect ventilation, and consequently the "Economy Combination Heaters" are especially adapted to warming school-buildings. A great many of them have been placed in educational buildings and institutions throughout the United States and Canada, and after a thorough trial have given universal satisfaction.

They are in use in the Phœnix Academy, Phœnix, N. Y.; the High-School Building, Fulton, N. Y.; the South Lancaster Academy, South Lancaster, Mass.; the Ross Street School and the Washington-Avenue School, Batavia, N. Y.; the Hamilton College Buildings, Houghton Seminary and Florence Seminary, Clinton, N. Y.; University College, Queens Park, Toronto, Ont.; Vine Street School-Building, Hazleton, Pa.; High School-Building, Hingham, Mass.; South Prince Street School, Lancaster, Pa.; Robbins School, Norwalk, Conn.; the S. D. A. School-Building, Rome, N. Y.; Union School-Building, Waterloo, N. Y.; the Orphans' Home, Watertown, N. Y.; the Bank of Batavia, Batavia, N. Y.; National Bank, Ephrata, Pa.; the Passage Sanitarium, Nunda, N. Y., and the Partridge Bank, Ovid, N. Y.

The Company is represented in Chicago by Messrs. Adkins & Hoffman, 177 E. Randolph Street; in Des Moines, Ia., by Walter Quinby, 718 West Locust Street; in Minneapolis, by A. A. Pond, 35 Washington Avenue, South; in St. Louis, by the Gage & Horton M'f'g Company, 1231 Olive Street; in New York, by Earl B. Chace & Company, 206 Water Street, and in Boston, by John Demarest, 112 Portland Street.

The Pease Company issues a very complete seventy-two page catalogue, giving full descriptions, which will be readily sent to any interested parties on application.

J. F. PEASE FURNACE COMPANY,
SYRACUSE, N. Y.

NOTES.

THE massive reflecting chandelier of special design which hangs from the centre of the audience-room of the West Harlem Methodist Episcopal Church, and which is one of the main ornaments of the church, was built by I. P. Frink of New York. It measures 18 feet 4 inches from brass ball at end of stem to the plate at the upper extremity of the stem, and weighs 600 pounds. It contains 130 lights. The gas-burners are made to resemble candles. The lower circle contains 80 gas-burners; it is surmounted by a silvered-glass reflector. Above this circle and the reflector are ten clusters of lights, each made up of seven gas-burners. The gas will be lighted by electricity. The chandelier brilliantly illuminates the audience-room, and is richly ornamented in polished brass and old gold. Mr. Frink has put up reflectors in thousands of churches and public places throughout the land, but has never surpassed the work done in the West Harlem Church.—*N. Y. Christian Advocate, Nov.* 3, 1887.

STAINED GLASS.

This list is taken from the latest stained-glass catalogue published by J. & R. Lamb, of New York, and the commissions have all been recently executed.

Church of the Transfiguration, New York City.
All Saints Church, New York City.
Church of the Holy Spirit, New York City.
Thirteenth Street Presbyterian Church, New York City
Laura Franklin Hospital, New York City.
Tabernacle Baptist Church, New York City.
St. Michael's Church, New York City.
Calvary Baptist Church, Fifty-seventh Street, New York City.
First Presbyterian Church, Brooklyn, N. Y.
St. Mary's Church, Brooklyn, N. Y.
Grace Church, Brooklyn, N. Y.
St. Luke's Church, Brooklyn, N. Y.
First Presbyterian Church, Trumansburg, N. Y.
St. Stephen's Church, Harrisburg, Pa.
St. Barnabas' Church, Baltimore, Md.
Baptist Church, Houston, Texas.
Christ Church, New Brunswick, N. J.
St. Mark's Church, Warren, R. I.
Presbyterian Church, New York Mills, N. Y.
St. Paul's Church. Paterson, N. J.
St. John's Church, Montgomery, Ala.
St. Paul's Church, East Chester, N. Y.
Church of St. John the Baptist, Germantown, Pa.
Grace Church, Kirkwood, Mo.
Christ Church, New Orleans, La.
Grace Church, Lynwood, Va.
St. James' Church, Painesville, O.
St. James' Church, Montgomery, Ala.
Episcopal Church, Santa Fé., N. M.
St. James' Church, Long Branch, N. J.
Church of the Holy Communion, South Orange, N. J.
First Baptist Church, Wappingers Falls, N. Y.
Presbyterian Church, Milton, Pa.
Christ Church, Danville, Pa.
Christ Church, New Brighton, N. J.
English Lutheran Church, Omaha, Neb.
Memorial Chapel, New Milford, Conn.
All Saints Memorial Church, Lakewood, N. J.
Church of St. Sacrament, Bolton Landing, N. Y.
St. Matthew's Church, Catawissa, Pa.
St. Peter's Church, Delaware, Ohio.
St. Mark's Church, Salt Lake City, Utah.
St. Paul's Church, Angelica, N. Y.
Stanford — The "Stanford" Memorial Building, Albany, N. Y.
Trinity Church, Plattsburgh, N. Y.
Christ Church, Richmond, Ky.
Baptist Church, Palestine, Texas.
St. Luke's Church, Annapolis, N. S.
Church of the Incarnation, Washington, D. C.
Grace Church, Waterford, N. Y.
Christ Church, Ballston Spa, N. Y.
Memorial Chapel, Linden Hall Seminary, Lititz, Pa.
First Congregational Church, Binghampton, N. Y.
St. Paul's church, Glen Cove, L. I.
St. John's Church, Far Rockaway, L. I.
Trinity Church, Marshall, Mich.
St. John's Church, New Rochelle, N. Y.
Christ Church, Walton, N. Y.
St. John's Church, York, Pa.
Reformed Church, Ashbury Park, N. J.
First Baptist Church, Tarrytown, N. Y.
St. Paul's Church, Cincinnati, O.
Presbyterian Church, Brewsters, N. Y.
Presbyterian Church, Salem, N. Y.
Soldiers' Chapel, Fortress Monroe, Va.
Grace M. E. Church, Marion, N. J.
Reformed Church, Bergen Point, N. J.
Presbyterian Church, Oneida, N. Y.
Kanawha Presbyterian Church, Charleston, W. Va.
Church of the Good Shepherd, Laredo, Texas.
St. Andrew's Church, Philadelphia, Pa.
St. John's Church, Clyde, N. Y.
First Congregational Church, Ticonderoga, N. Y.
St. Paul's Church, Syracuse, N. Y.
Grace Church, Nyack, N. Y.
Christ Church, Hackensack, N. Y.
Second Reformed Church, Hackensack, N. Y.
St. Luke's Church, Washington, D. C.
Christ Church, Brownville, Pa.
Memorial Chapel, East Litchfield, Conn.
St. John's Church, Salisbury, Conn.
Methodist Church, Durham, N. C.
Memorial Chapel, Ogdensburgh, N. Y.
First Presbyterian Church, Kansas City, Mo.
St. Paul's Church, Norfolk, Va.
Church of the Incarnation, Washington, D. C.
St. Paul's Church, Greensboro, Ala.
St. Matthew's Church, Bedford, N. Y.
Christ Church, Oil City, Pa.
Grace Church, Honesdale, Pa.
Baptist Church, Anthony, Kans.
Church of the Nativity, Maysville, Ky.
Methodist Church, Middletown, Conn.
St. John's Church, Johnstown, N. Y.
Zion Church, Greene, N. Y.
Christ Church, Sidney, Neb.
Church of the Good Shepherd, Augusta, Ga.
Christ Church, Tuscaloosa, Ala.
Trinity Church, Pottsville, Va.
Lathrop Memorial Building, Albany, N. Y.
Trinity Church, Princeton, N. J.
St. Michael's Church, Birdsboro, Pa.
St. James's Church, Greenville, Miss.
First Baptist Church, Jersey City, N. J.
St. John's Chapel, Bridgeport, Conn.
St. Paul's Church, San Diego, Cal.
Second Presbyterian Church, Newark, N. J.
Fourth Presbyterian Church, Chicago, Ill.
Christ Church, Louisville, Ky.
St. Paul's Church, Hoboken, N. J.
Christ Church, Ballston Spa, N. Y.
Zion Church, Greene, N. Y.
Christ Mission, Sidney, Neb.
Christ Church, Tuscaloosa, Ala.
St. John's Church, Johnston, N. Y.
St. James's Church, Painesville, O.

J. & R. LAMB,
59 Carmine Street, New York.

NOTES.

The sales of boilers by the Babcock & Wilcox Co., for September, are as follows; United States Electric Lighting Co., Newark, N. J., fourth order, 164 horse-power; Voight Milling Co., Grand Rapids, Mich., second order, 140 horse-power; Carmela G. Lagana, Palermo, Sicily, 40 horse-power; Walker Bros., London, for Colombo, Ceylon, fourth order, 25 horse-power; M. Lassig, Chicago, Ill., second order, 125 horse-power; House of Representatives, Washington, D. C., 73 horse-power; M. Cosserat, Amiens, France, third order, 84 horse-power; Tiberghein Fréres, Turcoing, France, second order, 240 horse-power; Walker Bros., London, for Colombo, Ceylon, fifth order, 15 horse-power; Edison Machine Works, Schenectady, N. Y. [making thirty-seven orders from the various Edison companies] 150 horse-power; East London Water Co., Waltham Abbey, England, second order, 93 horse-power; Anglo-American Brush Electric Corporation, Bosworth, England, 20 horse-power; S. B. Wilkins Co., Rockford, Ill., second order, 61 horse-power; Indiana Soldiers & Sailors' Orphans' Home, Knightsville, Ind., 240 horse-power; Sr. Don Julio F. Opesteyura, Cienfuegos, 736 horse-power; Electriciteits Maalschappy, Berlin, Germany, third order, 45 horse-power; Electriciteits Maalschappy, Berlin, Germany, fourth order, 45 horse-power; Harlem Lighting Co., New York City, 300 horse-power; Fowler Bros., Sioux City, 548 horse-power; McWhirter, Ferguson & Co., Edinburgh, Scotland, 40 horse-power; Chicago Sugar Refining Co., Chicago, Ill., second order, 816 horse-power; J. & G. Fowler, New York City, for export, 438 horse-power; making a total of 4,438 horse-power.

The new Broadway Theatre in New York, Academy of Music, Buffalo, and Vendome Theatre, Nashville, Tenn., have contracted with the Chalmers-Spence Co. of the first-named city for asbestos drop-curtains, with a view of protecting the auditorium from destruction in case of conflagration occurring on the stage. It is well known that asbestos is practically non-combustible, and a curtain made of it, that can be instantly dropped, will secure absolute safety in such cases.

E. H. Jemison, representing the U. S. Treasury Department has written a letter "recommending the use by the Department" of Rosenberg's Elastica Finishes. He says he found them to be "as represented in every respect," and "very superior in finish to those we are now using."

QUICK WORK.

New York, Oct. 11, 1887.

To the Eds. of the American Architect:—

Dear Sirs, — Some of the newspaper articles on the explosion at the Plant Milling Co. contained statements which would lead people to believe that the Babcock & Wilcox boiler may have exploded. Will you kindly give the enclosed news item a place in your columns, as it will serve to correct misstatements, and oblige, Yours truly,

THE BABCOCK AND WILCOX CO.
Nathaniel W. Pratt, Tr.

Quick Work. — The "Firminich" boiler at the mill of the Plant Milling Co., St. Louis, exploded Oct. 3d, destroying the boiler-house, and wrecking the Babcock & Wilcox boiler by its side. As soon as the *débris* could be cleared away, and the facts investigated, a telegraphic order was sent to the Babcock & Wilcox Co. for two new boilers of 500-horse power, and in *four days* the same were on the cars ready for shipment. This is doubtless the quickest time on record, where so large an amount of boilers were supplied on an unexpected demand.

PROPOSALS.

ROOFING. [At Boston, Mass.]

Office of the Boston Water Board,
City Hall, November 1, 1887.

Sealed proposals will be received at this office **until Monday, November 14th, at 12 M.**, at which place and time they will be publicly opened and read, for furnishing all labor and materials for performing the roofing and the copper-work for a pumping-station at Chestnut Hill, Ward 25, Boston. A separate bid required for each portion of the work; every proposal must be accompanied by a properly-certified check for $500, payable to the city of Boston, as surety for the execution of the contract if awarded. Proposals to be addressed to the undersigned, and indorsed, "Proposal for roofing (or copper-work), pumping-station, Chestnut Hill." The right to reject any and all bids reserved. For plans, specifications and proposal blanks apply at the office of the City Architect, City Hall.

H. T. ROCKWELL,
620 Chairman Boston Water Board.

RESERVOIR. [At St. Paul, Minn.]

Office of Board of Water Commissioners,
St. Paul, Minn., Sept. 22, 1887.

Proposals will be received at the office of Board of Water Commissioners, St. Paul, Minn., **until noon, on Thursday, November 10, 1887,** for building a distributing reservoir of about sixteen millions (16,000,000) galls. capacity.

Plans and specifications may be seen, and form of proposals obtained at the office of the Water Commissioners, St. Paul, from H. H. Harrison, St. Paul, or at the office of J. T. Fanning, Union Depot Building, Minneapolis, Consulting Engineers.

Specifications and plans of reservoir can be seen at the office of *Fire and Water*.

Each proposal must be accompanied by a bidders bond for the sum of ten thousand (10,000) dollars, signed by two sureties of Ramsey county, or a certified check for same amount of a State or National Bank in St. Paul.

The Board reserves the right to reject any and all bids.

By order of the Board of Water Commissioners.

JOHN CAULFIELD,
619 Secretary.

WATER-WORKS. [At Winchendon, Mass.]

Winchendon, Mass., October 17, 1887.

Proposals will be received for a system of water-works for Winchendon, Mass. The Fire Commissioners and a committee of citizens have been authorized to obtain plans for the construction of works for fire and domestic purposes. The water will be supplied from artesian or driven wells, or from Naukeag Lake in Ashburnham. The council has appropriated $500 for survey. Further information can be obtained from

619 THE WATER-WORKS COMMITTEE.

October 29, 1887. Sealed proposals will be received at the office of the Supervising Architect of the United

States Treasury Department, and opened at 2 P. M. of the 15th day of November, 1887, for all the stone and brick masonry, grading, sidewalk, etc., required for the approaches to the Court-House, etc., building at Waco, Tex. Each proposal must be accompanied by a certified check for $200, made payable to the order of the Treasurer of the United States. The right to reject any bids is reserved. The plans and specifications can be had, by applying to this office or the office of the Superintendent. WILL. A. FRERET, Supervising Architect. 619

October 29, 1887. Sealed proposals will be received at the office of the Supervising Architect of the United States Treasury Department at Washington, D. C., and opened at 2 P. M. of the 23d day of November, 1887, for the interior finish, plaster, joiner, marble-work, etc., of the United States Court-House, etc., at Dallas, Tex. Each proposal must be accompanied by a certified check for $500, made payable to the order of the Treasurer of the United States. The right to reject any bids is reserved. The plans and specifications can be had, by applying to this office or the office of the Superintendent. WILL. A. FRERET, Supervising Architect. 619

Treasury Department, U. S. Life-Saving Service, Washington, D. C., October 26, 1887. Sealed proposals will be received at this office until 2 o'clock P. M. of Saturday, November 19, 1887, for the construction of a life-boat station at Galveston, near east end Galveston Island, Tex. Plans and specifications containing full information and forms of proposal can be obtained from the Superintendent of the Eighth Life-Saving District, Custom House, Galveston, Tex.; Collector of Customs, New Orleans, La.; Superintendents of Construction, Life-Saving Stations, No. 24 State St., New York City, and upon application to this office. S. I. KIMBALL, General Superintendent. 620

October 27, 1887. Sealed proposals will be received at the office of the Supervising Architect of the United States Treasury Department at Washington, D. C., and opened at 2 P. M. of the 10th day of November, 1887, for furnishing and putting in place complete the iron stairs, etc., for the Post-Office, etc., at Hannibal, Mo. Each proposal must be accompanied by a certified check for $300, made payable to the order of the Treasurer of the United States. The right to reject any bids is reserved. The plans and specification may be had and any information obtained by applying to this office or the office of the Superintendent. WILL. A. FRERET, Supervising Architect. 619

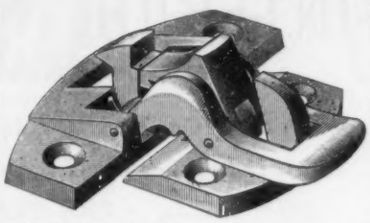
October 29, 1887. Sealed proposals will be received at the office of the Supervising Architect of the United States Treasury Department at Washington, D. C., and opened at 2 P. M. of the 16th day of November, 1887, for all the labor, tools, and materials necessary to put in place complete the system of plumbing required for the Court-House, etc., building at Shreveport, La. Each proposal must be accompanied by a certified check for $200, made payable to the order of Treasurer of the United States. The right to reject any bids is reserved. The plans and specification can be had by applying to this office or the office of Superintendent. WILL. A. FRERET, Supervising Architect. 619

October 29, 1887. Sealed proposals will be received at the office of the Supervising Architect of the United States Treasury Department, and opened at 2 P. M. of the 15th day of November, 1887, for all the iron furring, lathing and plastering required in the Post-Office, etc., at Peoria, Ill. Each proposal must be accompanied by a certified check for $300, made payable to the order of the Treasurer of the United States. The right to reject any bids is reserved. The drawings and specification can be obtained by applying to this office or the office of the Superintendent. WILL. A. FRERET, Supervising Architect. 619

Treasury Department, U. S. Life-Saving Service, Washington, D. C., October 31, 1887. Sealed proposals will be received at this office until 2 o'clock P. M. of Saturday, November 19, 1887, for the construction of a life-saving station near Quintana, Tex. Plans and specifications, with full information, and forms of proposal, can be obtained from the Superintendent of the Eighth Life-Saving District, Custom House, Galveston, Tex.; Collector of Customs, New Orleans, La.; Superintendents of Construction, Life-Saving Station, No. 24 State St., New York City, and upon application to this office. S. I. KIMBALL, General Superintendent. 619

DAVIS' AUTOMATIC SASH-FAST.

Patented November 24, 1885.



Window always Locked when Shut.

It will lock itself, when an ordinary fast would not work at all.

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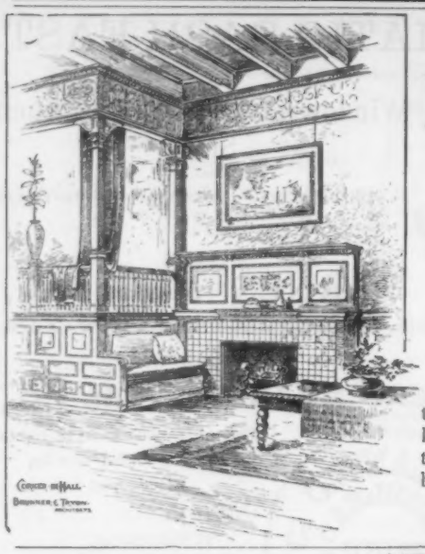

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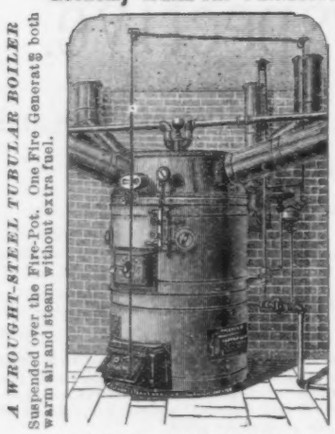

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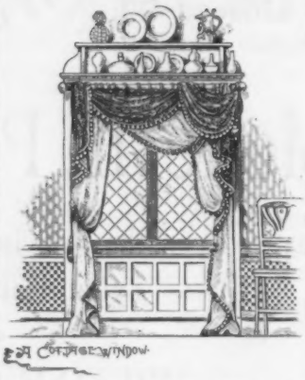

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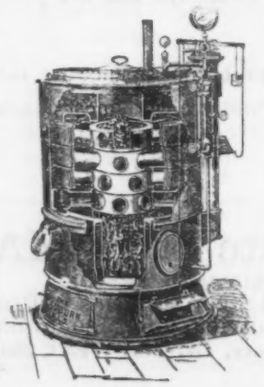

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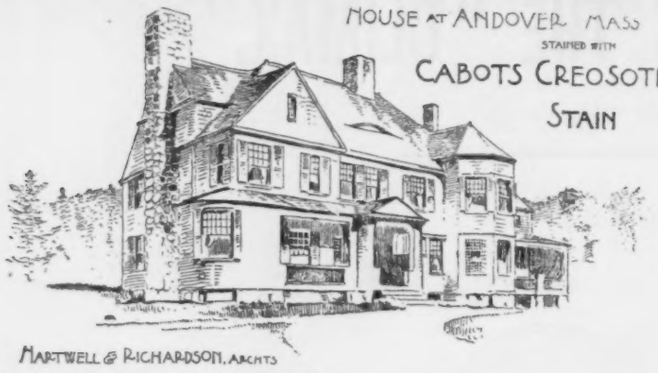

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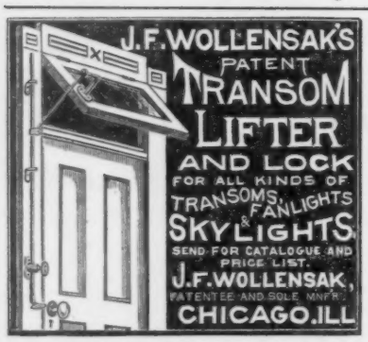

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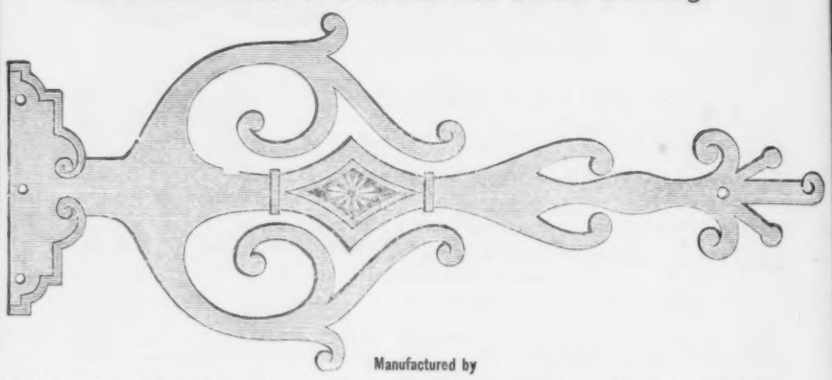

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